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ABSTRACT

This circular brings together suggestions from the Illinois Agricultural Experiment Station and the Illinois State Natural History Survey relating to orchard practices and pest control. It provides some basic steps in pest control and discusses some specific orchard pests such as grasshoppers, mites, mice, and rabbits. In addition, it gives some tips on using pesticides for pests on apples, peaches, nectarines, apricots, plums, cherries, and pears. Finally, general management practices such as tree nutrition, thinning peaches, and advancing apple maturity, and orchard chemical formulations are discussed. (BB)

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PEST CONTROL

AND RELATED ORCHARD PRACTICES IN COMMERCIAL FRUIT PLANTINGS

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Contents

Some Basic Steps in Pest Control 3
- Continue sanitation practices 3
- Insect traps can help 4
- Control general orchard pests (grasshoppers, cicadas, mites, apple tree borers and bark beetles, peach tree borers, mice, rabbits, deer) 5

Tips for Using Pesticides 12
- Most pesticides are poisonous 12
- Careless use of pesticides invites death 12
- Rating materials for toxicity 13
- Protecting honey bees from toxic materials 15
- Getting good fruit finish 15
- Using low-volume spraying . . 16

Controlling Pests 18
- Apples 18
- Peaches, Nectarines, and Apricots 23
- Plums 26
- Cherries 27
- Pears 27

General Management Practices 28
- Tree nutrition 28
- Chemical fruit thinning of apples 31
- Thinning peaches 33
- Bringing young apple trees into bearing 34
- Preventing premature bearing 34
- Preventing a preharvest drop of apples 34
- Delaying apple maturity 36
- Advancing apple maturity . . . 37
- Advancing peach maturity . . 38
- Apple scald and its control . . 38

Orchard Chemicals 39
- Chemical formulations 39
- Fungicides and bactericides . 40
- Insecticides and miticides . . . 44
- Growth regulators 49

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Spray Service Reports

The Spray Service Reports are periodic releases giving timely information on insects, diseases, and other orchard conditions. These reports are prepared by the Illinois Cooperative Extension Service and the Illinois State Natural History Survey. They are mailed via first class, stamped mail to insure rapid delivery. For the current price, contact the Department of Plant Pathology, N-519 Turner Hall, Urbana, Illinois 61801.

THE BATTLE against insects, diseases, and other pests in Illinois orchards must be fought every year. To help in the fight, various experimental agencies are constantly working out better methods of pest control. This circular brings together the latest suggestions from the Illinois Agricultural Experiment Station and the Illinois State Natural History Survey. You may need to adjust these suggestions to suit your own conditions — *but don't experiment with materials and methods not approved by the federal Environmental Protection Agency.* To do so may mean confiscation of the crop.

Pest-control measures are so closely linked with other operations that they cannot be separated easily. This circular includes the practices recommended for quality fruit — not just adequate pest control. For efficient operation, orchard practices must be well organized. You are urged to study the following pages carefully in order to cope better with the many problems that face you as a specialist in agriculture.

Spray schedules are revised and published annually in the Illinois Commercial Spray Schedule for Apples, Pears, Plums, Cherries, Peaches, Nectarines, and Apricots — the supplement to this circular. Copies of this circular and the Commercial Spray Schedule supplement may be obtained from your County Cooperative Extension Service Office or from the Office of Agricultural Publications, 123 Mumford Hall, Urbana, Illinois 61801.

SOME BASIC STEPS IN PEST CONTROL

Continue Sanitation Practices

With the general use of organic insecticides and fungicides and the increased cost of hand labor, many growers are omitting sanitation practices. This is a mistake. It is difficult to grow a high-quality crop when one depends entirely upon chemical treatments. The following practices should be observed.

For insects and mites

1. Carefully examine the top third and inner parts of the tree. These are the areas where insect and mite infestations often begin. You can cut the cost of sanitation and chemical control measures by concentrating efforts on these areas.

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2. If insects are a problem near the packing shed, store harvest tools such as used fruit containers and limb props in a closed or tightly screened building to prevent overwintering insects from returning to the orchard.

3. Collect and burn or chop all prunings and other debris. Destroy broken crates and containers, discarded sacks, large weed stems, corn stalks, and other overwintering sites of larvae.

4. Destroy or control insects on wild host plants near the orchard. If such host plants are on neighboring property, ask your neighbor for his cooperation.

5. Keep trees thinned out by annual pruning.

6. Jerk current season's watersprouts in early summer.

For disease control

1. Prune out fire blight infections as they appear. Cut at least 6 inches below the last point of visible infection. Between each cut, sterilize shears in a solution of 1 part Clorox and 4 parts water. A convenient method is to saturate a sponge with the Clorox solution and swab the shears between cuts.

2. Remove all dead wood from trees. Be careful not to leave pruning stubs. They die back and are a source of black rot and Botryosphaeria rot inoculum. The ends of broken branches should not be left jagged. Either smooth them or remove the entire branch.

For mouse control

1. Mow orchards closely in late fall.

2. Remove grass and weeds from around tree trunks in late fall.

Insect Traps Can Help

Insect traps that can be easily assembled are available from Pheromone Supply Service, Zoecon Corporation, 975 California Avenue, Palo Alto, California 94304. They have a sticky inner surface that traps insects attracted to a bait or a pheromone (female sex lure) placed inside. The bait is for apple maggot, and generally is made of a mixture of protein hydrolasate and ammonium acetate. It attracts both males and females. The pheromones which are for moth pests such as codling moth, oriental fruit moth, and several leafrollers will attract only the males. Pictures are supplied with pheromones for positive identification. Bait must be resupplied to the traps every 2 weeks; pheromones, every 6 to 8 weeks.

While commercial growers generally have not made use of these traps, they are a dependable monitoring device when used properly. They should be examined every other day or a minimum of twice weekly, recording the number by date for future reference. Traps for any one species should be labeled for the pheromone used and placed at least 300 yards apart. They will detect first appearance and the peak of the

first brood. Probably, the most practical use would be to detect the presence of the pest late in the season as spray intervals are lengthened and then stopped. Records on traps will help the grower make decisions about pest control, as will the commonly used techniques of watching large trees or ones nearest an outside source of infestation, or determining from fruit damage at harvest when the trouble occurred. Traps are only useful for detection and are not expected to be effective for control. Pheromones have been discovered for many moths. The particular ones offered for sale may change rapidly, so a personal inquiry to the address given previously would be the best way to obtain current information.

Control General Orchard Pests

Grasshoppers

Grasshoppers occasionally become troublesome in orchards. They are especially harmful to newly planted trees, but they may also feed on the foliage and fruit of older trees. They often hatch in dense grasses along streams, ditches, and fence rows, or in wooded undergrowth. Large numbers of young hoppers can usually be found in these areas in spring and early summer, before they move out into orchards. The most economical time to control them is when they are young and concentrated in small areas.

Cicadas

Cicadas have either a 13- or 17-year life cycle. During most of this time, they remain in the soil in the nymph stage. Adults emerge from the soil at about the time of the third cover spray, and spend a week or so in trees before the females begin egg-laying. They slit the bark on small branches and deposit eggs in the slit, thus damaging the trees.

The emerging adults can migrate short distances, flying with the wind. Control may be difficult if the orchard is next to a wooded area where cicadas are emerging. Fruit trees should be sprayed every 3 to 7 days while eggs are being laid. If the cicadas are not migrating from outside the orchard, less frequent applications of insecticide may be sufficient. (See the supplement to this circular for suggested insecticides.)

Mites

European red mites overwinter as eggs deposited in late fall on roughened areas on the underside of twigs or small limbs. A few eggs can start populations large enough to damage an orchard. Overwintering eggs begin hatching when trees are in the early pink stage and finish by mid-bloom. Newly laid eggs appear soon after petal fall.

Spotted mites overwinter as mature females under loose bark or under ground litter, often in large groups. They appear as orange masses to the casual observer. They spin webs loosely around them-

selves, the webs serving to waterproof the mass. During pink and early bloom, they come out of hibernation and begin feeding on the leaves nearest the tree trunk. By the first cover period, they start laying eggs and spreading farther into the tree.

Spotted mites migrate upward for more favorable food while European red mites migrate in all directions. Mites are easily disseminated by wind. When high populations force them to the top and outer portions of the trees, they will be blown downwind.

The most important predators of plant-eating mites are predatory mites. These predatory mites overwinter in the same locations as the spotted mites and sometimes live with them. They are similar in size to spotted mites, but are a whitish color during the winter. They emerge from hibernation at the same time as the spotted mites.

During the summer, they are straw-colored to reddish-brown — depending mainly on the food source. Eggs and young mites are nearly colorless like a drop of water. As they grow, the straw-color deepens. Color from food first forms the side loops of a figure eight on their top and with age, deepens the color of the whole body. Mature mites have parallel sides, but females become teardrop shaped when producing an egg. The predators (fallacis mites) have a shiny appearance, the plant-feeding mites do not. Generally, predators move faster than other mites. Predators grow and reproduce most rapidly when plant-feeding mites are abundant. When food becomes scarce, predator populations decline and reach a balance at a low level per leaf.

Control. High populations of red and spotted mites result from various circumstances — such as hot, dry weather; pesticide schedules which destroy predators; improper dosage and timing of miticides; incomplete coverage; varietal susceptibility; and winds. Control problems differ from orchard to orchard, and each grower must adjust his control measures accordingly.

A prebloom oil spray is suggested for controlling red mites. Miticides are usually not needed until several weeks after bloom. The trees most likely to have mite-control problems are those that have wide bands of herbicide applied near the trunks, those around which the ground litter is kept closely mowed, or those that are clean cultivated. Young trees do not have favorable overwintering sites (rough bark) in the tree, so fallacis mites move to the ground litter in the fall. During the spring, they seek food where they are. Since winter survival is often low, plants near their overwintering sites on the ground are most likely to provide the food they need to increase their populations. This is why spotted mite populations on ground plants early in the season are now considered favorable.

To further aid populations of predatory mites where herbicides are used, the treated band should be as narrow as practical and ground cover should be allowed to grow several weeks after bloom to provide living space for the predators. Perhaps one side of the row could be mowed,

waiting until growth starts in the mowed area before mowing the opposite side. Taller growth would also help the predators when they begin moving into the trees.

The most critical period for the success of the predator populations is the first several weeks following bloom. Avoid the use of any harmful pesticides such as Sevin, Lannate, Mesural, Morocide, Benlate, or any organophosphate insecticide that has not been applied regularly. If such compounds are used during this period, do not mow the ground cover for two weeks after application, to enable predator mites in the grass to survive.

Young orchards are the most critical ones to watch for mite development. Once the cultural management pattern is established, the development of pest mites will be similar from year to year, as long as no great changes are made in the pesticide program. If there has been no evidence of mite control by predators in a young block of trees, that block will need to be observed frequently and miticides applied whenever rapid increases occur in the number of pest mites. There is no need to "import" predator mites; they will be found anywhere in nature where pest mites have established annual populations. Trees can tolerate higher mite populations than growers generally allow. Severe bronzing should be prevented; but when predators are present, experienced growers allow moderate mite populations to be controlled by the predators. To gain this experience, growers may allow small "hot spots" to work themselves out naturally or may use one-sided applications or reduced miticide dosages to restrain rapidly increasing populations of red mites until the predators can increase enough to gain control.

Apple tree borers and bark beetles

Apple tree borers are seldom a problem in well-managed orchards.

The roundheaded apple tree borer usually burrows in the base of the trunk from 2 inches below the ground to a foot or more above.

The flatheaded apple tree borer works higher on the trunk and sometimes infests the branches. It usually locates on the sunny side of the tree. Weakened trees are especially susceptible, so the best protection is to keep the trees vigorous. If the borer is known to be present, shading exposed trunks and branches will help prevent infestation.

In recent years, the dogwood borer (or pecan borer) has been found with increasing frequency on apple trees of all ages. The larvae and the type of injury are similar to those of the lesser peach tree borer (below). However, the dogwood-borer larvae and the injured areas are smaller. Apple trees do not ooze gum like the stone fruits, so the only evidence of the dogwood borer is the sawdust from the tunnels that appears on the bark. The larvae feed where the bark is rough or where injuries have occurred, especially in spots not reached by regular orchard sprays. Interstem trees, trees where the graft union is above ground, and trees with injured trunks are especially vulnerable.

Bark beetles usually attack only weakened trees or branches, although they are occasionally found on healthy trees. Good tree vigor is usually the only control measure needed. Low tree vigor may be corrected by pruning, fertilizing, providing proper soil drainage, and controlling the many insect and disease pests such as scale and apple scab.

The insecticides applied in the cover sprays usually control roundheaded, flatheaded, and dogwood borers and bark beetles adequately if the spray material covers the bark of the trees. In problem areas (such as injured or interstem trees or spots on the bark which are not well covered by regular sprays), a special phosphate insecticide spray may need to be applied with a hand gun.

Peach tree borers

Three borers — the peach tree borer, the lesser peach tree borer, and the American plum borer — attack nectarine, plum, and cherry trees, as well as peaches. Many scaffold limbs, and even entire trees, may be lost when borers invade areas where the bark has been damaged.

The peach tree borer infests the inner bark of the tree trunk within 6 inches of the ground level. The lesser peach tree borer and the American plum borer infest the inner bark of the entire tree at any point where the newly hatched larvae can be protected by deep cracks or dead bark. Exudations from wounds and cankers are especially attractive to moths as egg-laying spots. Pruning cuts should be made so that they will heal rapidly.

Lesser peach tree and American plum borer moths begin emerging by May 1 in southern Illinois and by June 1 in northern Illinois. Peach tree borer moths begin emerging about a month later in both locations. Moths of all three species may be present until the end of September.

Regular control sprays applied with air-blast sprayers usually do not give adequate control of borers because vigorous leafy growth or weeds around the trunk prevent good bark coverage. Sprays with high-pressure hand guns are usually required to adequately cover all locations where there is dead bark or wounds on branches larger than ¼ inch in diameter. Special attention should be given to thoroughly spray all bark where gum exudes, since borer moths lay most of their eggs near such sites.

The number and timing of special borer sprays should be adjusted to the level of borer infestation. Peak moth emergence of lesser borers is during the 3rd week of May or about a week after shuck-fall stage and again during the 3rd week of July. Peach tree borer peak occurs with the 2nd peak of the lesser borer. A hand-gun spray just before each of the lesser borer peaks will reduce borer population, but one spray will not. For high infestations, apply an additional spray in late June half way between peaks or one in late August or both. If harvest restrictions prohibit the spray in mid to late July, delay the spray until immediately after harvest is completed. While there are usually two peaks for lesser

borer moths, they are present in infested orchards from late April to early October. Thorough coverage is the most important single factor in control.

There are some special situations. When borer populations are high in a few trees or when large wounds might girdle limbs or trunks, hand-cleaning to the live bark may be considered in order to stop further feeding damage immediately.

Wounds heal most rapidly between bud break and bloom. Painting or spraying the cleaned wound with an asphalt tree wound dressing or an effective insecticide will keep it from being reinfested. (For specific insecticides, see the supplement to this circular, the pesticide descriptions in this circular, and current insecticide labels.)

Mice

Meadow mice are a constant threat to orchards throughout Illinois. Prairie mice and pine mice are not so widely distributed, but they can cause serious damage where they become established. All three species may be found in the same orchard.

Trapping with common snap traps helps in identifying the species and in monitoring the size of the population. Set the traps at right angles to the surface runs and cover the traps lightly with grass clippings.

Pine mice have short tails that are about the same length as the hind foot. Meadow mice and prairie mice have long tails that are about twice the length of the hind foot. Distinguishing between meadow mice and prairie mice is difficult. The fur on the stomach of meadow mice is grey; on prairie mice, it is buff color.

Meadow mice live mostly above ground in the orchard cover but they may make shallow tunnels for nesting. Their surface trails are readily visible. They damage trees by eating the bark on the trunks near or slightly below ground level. They seldom eat bark from the roots. Trees may be partially or completely girdled.

Prairie mice live both above and below ground. Like meadow mice, they may eat the bark on the trunk. But they may also eat small roots and the bark of larger roots as do pine mice.

Pine mice live in underground burrows and make extensive underground tunnel systems. They journey above ground only occasionally. They eat small roots and bark from the larger roots. They usually do not damage the trunk.

When pine mice are suspected, look for small entrances into their underground burrows and tunnels. The entrances are usually partially covered with grass clippings and fallen leaves, and may be hard to see. Remove the litter to expose the entrances.

Control. A great aid in controlling meadow mice and prairie mice is to destroy their cover, exposing them to owls, hawks, cats, foxes, skunks, and other predators. Close mowing with rotary mowers is recommended, especially in the late fall.

Also, eliminate grass and weeds in a circle with a 2-foot radius around the trunk. This can be done by using herbicides[1] or by hand hoeing in the fall.

Tree guards constructed from ¼-inch mesh hardware cloth may be used. To be effective against meadow mice the guards must enclose the trunk from several inches below ground level to about 12 inches above ground level (18 inches if protection from rabbits is needed).

Cultural practices must be supplemented with poison bait applications to insure adequate control of meadow and prairie mice. Grain treated with zinc phosphide makes a good bait. A mixture of cracked corn and oats is more effective than corn alone. Broadcast application at a rate of 6 to 10 pounds per acre is suggested for commercial orchards. Apply between October 15 and November 15 on a sunny, calm day, when the mice will be active.

Poison grain may also be used for spot treatment whenever activity by meadow mice is noted. Another effective bait for spot treatment is fresh apple cubes treated with zinc phosphide. Cut apples into ½-inch cubes and add 1 level teaspoon of zinc phosphide per quart of cubed apples. Use three or four cubes per tree.

Damage by meadow and prairie mice is usually greatest during the winter, when other food is scarce. However, damage can occur at other times. Check for mouse damage throughout the year.

Pine mice seldom feed on the surface of the ground, thus surface baiting as suggested for meadow and prairie mice is not effective. Bait must be placed in the burrows or in artificial trails.

Machine-baiting with a trail-builder mounted on a tractor is the most effective method of treating large areas infested with pine mice. The trail-builder constructs artificial trails just below the soil surface and places bait in these trails. Use zinc-phosphide-treated grain. Make artificial trails along both sides of the tree row at the drip line of the trees. Good sod and reasonably moist earth are necessary to make good trails. It is essential that the trail-builder be properly adjusted for existing soil conditions and that the tractor be operated at a slow speed in order to avoid tearing the sod. For spot treatment of smaller infested areas, place zinc-phosphide-treated grain in the entranceways to underground burrows.

All three species of mice may move into the orchard from adjacent areas, especially if these areas are wasteland with heavy cover. Baiting these areas will greatly reduce the danger of reinfestation in the orchard.

CAUTION: When mixing or handling baits, work outside and avoid breathing zinc phosphide dust. Wear gloves when handling and distributing baits. Afterward, carefully wash hands and utensils. Store toxicants, baits, and contaminated gloves in a safe, well-ventilated place.

[1] See publication H-659, available from the Department of Horticulture, 124 Mumford Hall, Urbana, Illinois 61801.

Rabbits

Rabbits eat bark from the trunks of young fruit trees. When deep snows crust, they may be able to damage the lower branches.

A guard made from an 18-inch square piece of hardware cloth will protect the lower trunk from rabbits. Make a cylinder around the trunk by tying two sides together. Plastic guards that wrap around the trunk are available from orchard supply firms.

The fungicide, thiram, acts as a taste-repellent to rabbits when applied to the trunk and lower branches of fruit trees. If thiram is applied with a latex-type sticker such as Wilt-Pruf or white outdoor latex house paint, it remains effective for several months. In addition to sticking on the thiram, the white latex paint reflects the sun's rays and thus reduces the temperature fluctuations of the treated parts.

Use the Arasan 42-S formulation of thiram containing 4 pounds of thiram per gallon. For a paint brush application of Arasan 42-S plus Wilt-Pruf, mix at the rate of 1 ounce of Wilt-Pruf to 1 quart of Arasan 42-S. Paint on the tree without dilution. For spray application, mix at the rate of 1 quart of Arasan 42-S plus 1 pint of Wilt-Pruf plus 3 quarts of water.

To apply Arasan 42-S plus white outdoor latex house paint with a paint brush, mix at the rate of 1 quart of Arasan 42-S plus 2 quarts of latex paint plus 2 to 3 quarts of water. For a spray application of the Arasan-paint mixture, mix at the rate of 1 quart of Arasan 42-S plus 2 quarts of white latex paint plus 6 to 10 quarts of water.

Some growers have reported success in using the wettable-powder formulation of thiram and latex paint to make a spray mixture. The rates are in the range of 1½ pounds of 65W thiram plus 2 quarts of white latex paint plus 6 to 10 quarts of water. Make a slurry of the thiram with a small quantity of water, mix in more water, then add the paint.

Apply the thiram mixtures in the fall on days when drying conditions are good. Make fresh mixtures daily. After standing, the solids will settle and are difficult to re suspend.

Deer

Deer feed on the twig tips during the dormant season and occasionally during the growing season. Bucks preen their antlers on young trees, causing serious breakage of the branches. The damage from feeding and preening is most serious in young orchards.

The most effective material to discourage deer from entering an orchard is tankage prepared for livestock feed. Place 2 or 3 tablespoons of tankage in a small cloth bag and hang one bag on each tree. This treatment should be effective for 3 to 5 months, depending on weather conditions. However, treated trees should be visited periodically to check on the effectiveness of the treatment. Raccoons and other wildlife sometimes eat tankage.

Small cloth bags can be purchased from the Millhiser Sales Corporation, P.O. Drawer 1117, Richmond, Virginia 23208 and from the Illinois Fruit Growers Exchange, Cobden, Illinois 62920. Tankage can be purchased from local feed dealers.

TIPS FOR USING PESTICIDES

Most Pesticides Are Poisonous

Some pesticides are hazardous to the operator; some are toxic to plants; some may leave toxic residues that are dangerous to consumers; and a few are hazardous because they tend to contaminate the flavor of foods or feeds. So be sure to observe strict precautions when using pesticides.

To learn the hazards of a specific pesticide, *read the label* on a current season's pesticide container. All pesticides sold in interstate commerce have been registered and labeled under federal regulations. The label contains the most accurate information that was available on specific uses and hazards of a material at the time of printing.

Careless Use of Pesticides Invites Death

The organic phosphates parathion, Systox, and Trithion are especially dangerous chemicals. Though other organic phosphate materials are not as dangerous as these three, all phosphates have an additive effect, and repeated exposure to them can cause health problems.

When using organic phosphates follow these precautions:

1. **Be extremely cautious when using with oil,** as oil causes the skin to absorb more organic phosphate.

2. **Do not spray from the inside of the tree.**

3. **Secure a respirator that has been officially approved** for use with organic phosphates. The following respirators are suggested:

Respirator R-6058, Cartridge No. R-58
American Optical Co., Southbridge, Massachusetts 01550

Respirator 93938, Replacement Filter Cartridge No. 93939
Mine Safety Appliance Co., 400 Penn Center Boulevard,
Pittsburgh, Pennsylvania 15235

Agritox Respirator, Cartridge Filter Package R705
Wilson Products, Inc., Box 622
Reading, Pennsylvania 19603

4. **Use the mask** to protect lips, nose, and mouth from accumulating residue, especially while preparing spray mixtures. Wear the mask while spraying in the orchard whenever there is danger of inhaling the pesticide.

5. **When spraying, inform someone** of your location and time schedule so he can monitor the spraying operation and provide help in case of an accident or illness.

6. **Stand out of the drift** when putting spray powders into a tank or when filling a duster — even when you are wearing the proper mask.

7. **Do not wash spray material through the screen** into the tank. Sift it in quickly with the screen removed.

8. **Do not breathe dust or powder.**

9. **Dust with the wind** and be careful of the turns at the ends of the rows. A duster or sprayer operated by one man with controls at the tractor is safer than the manually operated, two-man outfit.

10. **Keep a pail of water and soap handy** when loading sprayer. Wash hands thoroughly after each contact with the material and before touching the lips, eyes, etc., or eating any food.

11. **Do not smoke, eat, or drink** while spraying or dusting pesticides.

12. **Take a hot bath** or shower and put on clean clothes when the spraying is finished each day.

13. **If clothes or shoes become wet, remove them immediately,** take a hot bath or shower, and put on clean ones.

14. **Always store pesticides in the original containers with the original label.**

Atropine is the emergency antidote for organic-phosphate poisoning. Keep a supply of atropine tablets on hand (1/120 grain or 0.5 mg.). You will need a doctor's prescription to get them. Never take atropine or similar drugs until AFTER warning symptoms appear. Symptoms of organic-phosphate poisoning include headache, blurred vision, weakness, nausea, cramps, diarrhea, and discomfort in the chest. If you feel any symptoms while spraying with an organic phosphate, quit spraying, take two atropine tablets at once, and go to a doctor.

If you handle organic phosphate insecticides regularly, you should go to your doctor periodically for blood cholinesterase determinations.

Rating Materials for Toxicity

The list in the table indicates how various insecticides and miticides compare in their toxicity to man. It does not necessarily include only those suggested for use. The ranking is approximate. The information has been derived from many different sources and no standard comparative method has been applied to all materials. Thus the list should serve only as a relative guide.

The materials are ranked in two ways — for oral and for dermal toxicity. Oral toxicity results from intake through the mouth and nose in swallowing or breathing. Dermal toxicity results from pesticide con-

tact with the eyes or skin. A material may be higher in one type of toxicity than in the other. Thiodan, for example, rates below Guthion in the oral-intake column, but is higher in the skin-contact column.

In general, the oral intake rating is probably the more important. It is not difficult to protect the skin, but it is difficult to keep the mouth and nose covered at all times. Exercise the utmost care when using these chemicals.

INSECTICIDES AND MITICIDES RANKED IN ORDER OF DECREASING TOXICITY TO WARM-BLOODED ANIMALS, INCLUDING MAN

(Inclusion of a material in this list does not indicate suggested use)

Oral toxicity (by intake)		Dermal toxicity (on the skin)
	Very high toxicity	
Phosdrin		Phosdrin
Parathion		Systox
Endrin		Parathion
Lannate		Endrin
Guthion		Trithion
Trithion		
Phosphamidon	**High toxicity**	
Carzol		
Dieldrin		Dieldrin
Thiodan		Thiodan
		Phosphamidon
	High toxicity	**Moderate toxicity**
		Guthion
Nicotine		Nicotine
Diazinon	**Moderate toxicity**	Cygon
Zolone		Diazinon
Mesurol		Mesurol
Lorsban		Zolone
Imidan		
Cygon	**Low toxicity**	
		Kelthane
	Low toxicity	Morestan
		Lead arsenate
		Ovex
		Omite
Sevin		Lannate
Kelthane		Lorsban
Lead arsenate		Imidan
Karathane		Vendex
Plictran		Plictran
Vendex		Sevin
Malathion		Carzol
Ovex		Malathion
Omite		Karathane
Tedion		Tedion
Acaralate		Acaralate

Protecting Honey Bees From Toxic Materials

Pollination by bees is essential in producing commercial crops of apples and some other fruits. Growers, beekeepers, and pest-control operators must cooperate to keep the losses of honey bees at a minimum while providing necessary pest control.

Many of the pesticides suggested in this circular are highly toxic to honey bees and other beneficial insects. Some materials, including several that are low in toxicity to humans, are especially toxic to bees and should not be used when bees are visiting the blossoming trees or when their hives are located in the orchard.

If you must use pesticides when bees are present, choose materials that are least toxic to them. Spray at the safest times for bees — that is, when they are not flying because of darkness or cool temperatures. Keep spray materials from drifting into bee hives, onto other crops or weeds in bloom, or into sources of drinking water for bees. Many bees can be killed by residue on dandelions in orchards in the spring, and on clovers in the summer when the trees are not in bloom. Whenever you must apply materials hazardous to bees on attractive blossoms, notify the beekeeper in advance so that he may move, cover, or otherwise protect his bee colonies.

Some materials, such as ethion, Systox, and Trithion, are toxic to bees only 3 to 5 hours after application. Other compounds, especially many chlorinated hydrocarbons and Sevin, are hazardous to bees for several days. When applied as a pink spray in warm weather, they may kill bees during the bloom period. The danger periods for some materials are as follows:

Material	*Days*	*Material*	*Days*
Diazinon, parathion	1	Guthion	2-4
Cygon	1-2	Imidan	4-7
Malathion, phosphamidon	2	Sevin	5-7

For further information, see the Illinois Cooperative Extension Service Circular 1138, *Pesticides and Honey Bees.*

Getting Good Fruit Finish

Obtaining good fruit finish on apples is a perennial problem in Illinois because of our variable weather patterns. A roughness of the skin, commonly called russet, is most likely to occur on Golden Delicious but sometimes affects other varieties. Although russet does not affect the flesh, it detracts from the appearance of the fruit, thus reducing its value.

Weather conditions alone can cause russet, but most russet results from a combination of weather conditions and spray programs. Certain chemicals are more likely to cause russet than other chemicals when applied during certain weather conditions.

The most critical period for russet development is between the pink-bud stage and the third cover spray. But the period from the fourth cover spray until harvest is also important.

Here are some precautions for getting good finish:

1. Do not apply the bloom, calyx, or first two cover sprays within 24 hours before a predicted freeze, during a freeze, or within 24 hours after a freeze. Almost any chemical will damage fruit if used during these weather conditions. Glyodin and Cyprex are especially dangerous in freezing or near-freezing weather. To be completely safe, do not spray when temperatures are below 45°F., particularly in the lower elevations of the orchard.
2. Do not use any copper materials (bordeaux mixture, insoluble coppers) except during the dormant and delayed dormant periods.
3. Do not apply cover sprays in the heat of the day. Never spray when the temperature is above 90°F. During the late spring and summer, spraying at night, in the early morning, or after 4:00 p.m. is suggested.
4. Do not use sulfur in any form when the temperature is 85°F. or above.

The suggestions given apply to all varieties but are most pertinent for Golden Delicious. Three additional precautions should be taken for this variety:

1. Do not use urea for foliar feeding.
2. Select fungicides that are least likely to cause injury. Captan, Dikar, Polyram, and zineb are the best suggestions.
3. The organophosphates are likely to cause injury in the calyx spray. Most orchards that are well cared for and in which other varieties are sprayed with an insecticide in the calyx and first-cover periods probably could use fungicides only in these two sprays on the Golden Delicious and would have less culled fruit. Make sure the aphids are controlled before the pink-bud stage.

If disease, insects, or mites should become critical during any period when spraying might cause russet, then you will have to decide which is the lesser of the evils.

Using Low-Volume Spraying

Effective pest control by means of chemicals depends on having a sufficient amount of an effective chemical distributed to all necessary sites in order to stop pests from causing harm. If more than 150 gallons of water are used to carry the chemical to an acre of mature trees, a dilute spray is being used; if less than 150 gallons are used, low-volume spraying is being employed. Air-blast sprayers use large volumes of air to distribute the water. The water function is to carry the pesticide in a form that is effectively deposited on the plant surface. Water volume is

only important to get the chemical to the surface before drying and in some cases to hold the chemical in water to aid its transfer into the plant.

Sprayers are designed to break up the spray mixture into drops by means of a high air speed over the release point or by a combination of nozzles and air speed. The size and distribution of drops in the air stream and the nature of the air stream is mostly determined by the manufacturing design. The output in gallons per minute is also a matter of design. Sprayers should be operated in the optimum range suggested by the manufacturer. With a well-engineered air stream and spray distribution within that air stream, the volume of air per minute is the most important measure of the size capability of an air-blast sprayer. Drops of the spray mixture must be carried to all parts of the tree with sufficient speed or turbulence to get a surface deposit of the mixture. The travel speed of the sprayer must be matched to the ability of the air stream.

Most air-blast sprayers have the capability within their optimum range to apply low-volume sprays. Many growers have been lowering the volume of water used. Traditionally, the chemical dosages of orchard sprays have been expressed in amounts per 100 gallons, which were based on a range of 300 to 400 gallons per acre or a thorough wetting of all plant surfaces. Growers adapt these dosages to a number of variations, such as tree spacing, size, and height as well as pruning and the wind speed and direction. Judgments for adjustments of the dosage to the amount of water used, the output of the sprayer, or changes in the frequency of application are based on the success of the control measures. Increasingly, effective and expensive pesticides and well-designed sprayers have allowed growers to gradually reduce both the gallonage of the spray and the actual chemical dosage per acre. Some growers have successfully gone as low as 100 gallons per acre for an application rate, while still using dilute dosage rates.

Dosage rates per acre as given on pesticide labels are 2 to 4 times the 100-gallon dosage, generally with a reduction of 20 percent to compensate for the loss via runoff when the surface is not completely wetted. The dosage rates shown on the label often include a range to control moderate to high infestations. Growers make the same adjustments from initial dosage rates per acre as they do from the 100-gallon rates.

For example, young trees in their early bearing years have less leaf and fruit surface per acre of orchard than they will have when mature. During their early bearing years, therefore, such trees will not require as much pesticide per acre as they will later. Also, the rate per acre for each pesticide should be adjusted according to the severity of the pest problem it controls. During wet weather in the spring which fosters apple scab infection, a higher rate of scab control pesticides per acre may be needed; but the rate per acre for insecticides applied with the scab-controlling materials may not need to be increased.

To begin low-volume spraying, the grower should get as much information from manufacturers and from other growers as possible. The size of the trees, mainly the height, and the time required to complete an application will determine the capacity needed for the sprayer. The amount of pesticide needed can be determined either from successful operating experience or by following the minimum suggested for dilute-spray or per-acre recommendations for a specific block of trees. Set a driving speed that will permit the sprayer to blow air into all parts of the tree under normal conditions. Either compute the speed or actually spray with water to find the number of gallons required to cover the block. Add the pesticide required for that many gallons or to a tank of water in equal proportions and try it.

Low-volume spraying reduces the pesticides, water, and labor needed. Refill time is less, so spraying time is also reduced. In all but a few situations where leaf wetness is needed, pesticides can be adequately applied at quite low gallonages per acre. However, mistakes can be amplified as the volume becomes lower. Calibration at the various outlets needs to be done accurately, and output must be watched closely. For low-volume versus regular spraying, the trees need more careful pruning, and greater skill is required in the sprayer operation since it is more difficult to see what is being applied; also, a stricter observance of proper spraying conditions is needed. Many growers find the advantages of low-volume spraying outweigh the disadvantages.

CONTROLLING PESTS

Apples

This section describes the apple pest problems to watch for during the various stages of growth and discusses methods and materials for controlling them. Specific pesticide suggestions are given in the annual supplement to this circular.

With a current copy of the supplement, this circular, the Illinois Fruit Calendar, orchard records, and your previous spraying experience, you can plan a basic schedule for each block. Keep observing your orchard for pest problems, subscribe to and use the weekly Spray Service Report, and attend local and state orchard meetings.

Dormant-to-green tip stages. The major insect and mite pests are scale, European red mite eggs, and aphid eggs. Other pests may be present, but they usually do not require special attention at this time.

Superior oil is suggested for scale insects and red mites. It has a high percentage of paraffin, which kills these pests by suffocation. Since the oil's killing action is by suffocation rather than by toxicity, thorough coverage of each scale insect and red mite egg is necessary for control. Thus, thorough coverage is the most important consideration in oil spraying. The calmer the day, the better the coverage will be.

Two gallons of oil per 100 gallons of dilute spray is a full dosage. As the scale insects start to grow and the red mite eggs near hatching, they are easier to kill. At the tight-cluster stage, 1 gallon of oil is sufficient. The addition of phosphate insecticides to oil sprays does not increase the kill of scale insects or of red mite eggs.

Oil is not very effective against aphid eggs. A systemic phosphate for aphid control should be added to one of the sprays during the green-tip to tight-cluster period.

Sulfur and Dikar are not compatible with oil. Where mildew is a problem and sulfur or Dikar is needed for control, oil should be applied in the dormant stage. Sulfur or Dikar can then be applied as the green tips appear. See the half-inch green to tight cluster section for more information on mildew control.

Protection against scab must begin no later than the green-tip spray. Difolatan applied during silver-tip to green-tip stages will control scab for up to 6 weeks in a normal year. If Difolatan is not used, Cyprex or Benlate should be applied at green tip. Sulfur, Dikar, or Benlate should be applied for mildew if necessary.

As a cleanup spray, copper sulfate may be combined with oil or used alone in the strictly dormant stage. This is primarily an aid in fire blight control but may also help control Botryosphaeria, black rot, and blotch. After the buds begin to swell, copper sulfate may cause injury. Do not combine copper sulfate with dinitro or with phosphate materials.

An 8-8-100 bordeaux-oil combination is also a good cleanup spray. It acts in the same manner as copper sulfate alone. It will last longer as a residue than copper sulfate and is less likely to cause injury. It is most effective when applied during the silver-tip period.

In the green-tip spray, Cyprex or Benlate should be applied for scab control; sulfur, Dikar, or Benlate, for mildew, if necessary.

Half-inch-green through tight-cluster spray. *Insects and mites.* A systemic phosphate should be applied once for aphid control if it was not included in the green tip spray. It will also reduce leaf rollers.

The oil sprays discussed in the dormant-to-green tip section may be continued, if they do not conflict with the use of certain fungicides. To avoid leaf injury do not apply oil after, with, or just before captan, sulfur, Dikar, or Karathane. Oil is compatible with Cyprex, Benlate, and ferbam. If oil is being used at this time, a mix should be made in a glass jar to test compatibility. Always add the other materials first, and keep the mixture agitated while adding oil. Oil may be reduced to 1½ gallons per 100 gallons of dilute spray at the half-inch-green stage and to 1 gallon in the tight-cluster period.

Diseases. Where powdery mildew is a problem on susceptible varieties, oil should not be applied during the half-inch-green to tight-cluster stages. For suggestions on applying oil where mildew is a problem, see the discussion under dormant-to-green tip sprays.

Powdery mildew can be serious on Jonathan, Rome Beauty, and Golden Delicious. It decreases fruit quality and reduces yields. It overwinters in the buds making them more susceptible to winter injury and causing many of them to die during the winter. If not controlled, powdery mildew becomes more serious each year.

Sulfur is the most effective material to use against powdery mildew. Karathane, Dikar (which contains Karathane), and Benlate are also effective and are useful during the summer when high temperatures prevent the use of sulfur.

The program for mildew control must start in the green-tip stage. This is when the overwintering mildew spores start to grow and infect the new leaf tissue. The program must be continued with regular control sprays into July. Mildew is the opposite of scab in that it spreads more rapidly during dry weather than during wet weather. Mildewcides must be applied during dry weather, even though scab control materials are not needed.

As with all disease-control materials, thorough coverage is necessary. Mildew is usually most prevalent in the tree tops, where good coverage is difficult to obtain. Once established in the tops, mildew can spread rapidly to other parts of the tree as the season progresses. Special efforts in spraying tree tops may be needed.

Scab is a problem throughout Illinois, and control must be established in prebloom sprays. Cyprex, Benlate, and Difolatan are the most effective materials against scab. Captan and Dikar also give good control. Sulfur applied for mildew gives some protection against scab.

Problems with scab control are usually associated with wet weather. Weekly sprays during the prebloom period should protect the trees adequately against scab. Strains of the apple-scab fungus resistant to Benlate and Cyprex have been reported in neighboring states. Alternating fungicides or using fungicide mixes is recommended to prevent the appearance of tolerant strains. Dusting is suggested during prolonged wet spells when spraying is difficult or impossible. Dusts containing sulfur, captan, or Cyprex are available.

Pink (when the buds are pink but no blossoms have opened). *Insects and mites.* If a systemic phosphate was used in one of the earlier sprays for aphids, insect control will not usually be needed in the pink spray. However, curculio adults will be emerging from trashy areas, and a few rows of apples next to timber, overgrown fence rows, and similar spots may need to be sprayed with a phosphate.

Avoid poisoning honey bees and other pollinating insects. During warm weather there is not much time between pink and early bloom.

Diseases. Scab and mildew control programs must be continued and rust control must be started. For rust, any of the dithiocarbamate-containing fungicides (zineb, Dikar, Polyram, Manzate 200, etc.) would be suggested.

Where mildew scab, and rust are all problems on the same cultivar, you may choose to use Dikar alone or combinations of fungicides. Always read the label and check for compatibility; also, for the legal uses of such mixes.

On Jonathan and other varieties susceptible to fire blight, streptomycin should be started in the late-pink spray. Zineb is a weak bactericide and may reduce early fire-blight infection. See the fire-blight discussion in the following paragraphs.

Bloom sprays. Some fungicides are toxic to pollen and will hinder fruit set. It is important *not* to apply fungicides during the full-bloom stage, especially during years of light bloom.

On varieties susceptible to fire blight, bloom sprays of streptomycin should be applied at four-day intervals. The blossom-blight phase of this disease is usually erratic and unpredictable in Illinois. Since it can be controlled by streptomycin, this material should be used when conditions are optimum for disease development. Because of the cost, however, streptomycin should not be used if it is not needed.

Temperature and moisture conditions during blooming are not the only climatic factors that determine whether blossom-blight infections will occur. Prebloom freezing temperatures are now thought to reduce infections by killing a high percentage of the viable bacterial cells.

Bacteria in a canker multiply as the tree develops in the spring. At approximately the pink-bud stage, bacterial ooze can be found on the surface of the cankered area. This is the source of inoculum (bacteria) that infects the blossoms. However, a sudden freeze will destroy a high percentage of these bacterial cells. A reduction of the viable cells means less likelihood of blossom infection.

After a freeze, the number of "degree days" required for the bacteria to again reach a potentially dangerous inoculum is computed from 65°F., the minimum temperature for the growth of the organism. Should the maximum daily temperature reach 70°F., this would equal 5 degree days (70°F. − 65°F. = 5 degree days). Observations indicate that 30 degree days are needed for the bacteria to again reach a dangerous population level. For example, 2 days of a maximum temperature of 80°F., or 3 days of 75°F., or 6 days of 70°F. following a freeze would provide the number of heat units necessary for a serious infection of blossom blight. At temperatures above 86°F., however, the bacteria do not develop rapidly. Thus, fire-blight infection will not occur when the temperature remains below 65°F. or when it rises above 86°F. The following points will help in understanding the fire blight.

	Temperature		*Moisture*
For blossom infection	At least 30 degree days between latest freeze and early bloom	– plus –	Adequate rainfall during prebloom period

– plus –

	Maximum temperature of 70°-80°F. during early bloom.	Very light rain and high humidity during early bloom.
For no blossom infection	Freeze close to bloom and less than 30 degree days between latest freeze and early bloom – or – Maximum temperature lower than 65°F. or higher than 86°F. during early bloom.	Drouth preceding and during bloom – or – Excessive moisture during early bloom.

Calyx and first-cover sprays. The calyx and first two cover sprays may be critical in obtaining good fruit finish. (Please refer back to the section on that subject.) Apply the calyx spray when three-fourths of the petals have fallen; and the first-cover spray, 7 to 10 days later.

Insects and mites. Leaf roller eggs will be hatching. Curculio adults will be making feeding punctures and egg-laying punctures on the young fruit. Codling moth adults will be emerging and laying eggs. A phosphate insecticide should be included in both the calyx and first-cover sprays, except on Golden Delicious. Imidan is weak on leaf roller control. For calyx sprays on Golden Delicious, see the sections on good fruit finish and low-volume spraying. If aphids persist, use a systemic phosphate in addition to the phosphate insecticide.

Diseases. Protection against scab, rusts, blotch, powdery mildew, and frog-eye diseases must be included in these sprays.

On Jonathan and other susceptible varieties, protection against the twig-blight phase of fire blight should be started. Use streptomycin, preferably applied alone, when the humidity is high, so the spray will dry slowly. These conditions are most likely to occur between 10 p.m. and 3 a.m. Daytime sprays of streptomycin are not very effective. Use 50 ppm of streptomycin if the temperature is 65°F. or above and 100 ppm if it is below 65°F. at the time of application. Apply streptomycin on a 7-day schedule into July.

Remaining cover sprays. See the earlier discussion about getting good fruit finish. The second, third, and fourth cover sprays are normally 7 to 10 days apart. This is a critical period for the control of several insects and diseases.

By the fifth cover spray, pest control should be well established and spray intervals can often be extended to 14 days. Adjustments in spray intervals should be made according to weather conditions, the threat of pest infestation, and your past experiences. The twig-blight phase of fire blight is an exception. (See the discussion on twig blight control in the section on calyx and first-cover sprays.)

Insects and mites. Scale crawlers begin appearing about the time of the third and fourth cover sprays. Where control is needed, parathion and diazinon are the most effective insecticides. Parathion is available in

microencapsulated formulations, and diazinon may be. Those formulations greatly reduce the use hazard and extend the time of effective control. When live scale are found anytime during the season, the infested areas should be kept under close observation, even after apparently effective control measures have been applied.

Red mites are most likely to become a problem during the early part of the cover-spray period. (See the discussion about mites in the section on controlling general orchard pests.)

As growers reach mid-season and begin to lengthen the time between applications or as they reduce the number of applications and amounts of pesticides applied per season, their orchards need to be watched more closely. Minor pests such as leaf hoppers, leaf miners, and various species of leaf feeders have appeared under such situations.

Apple maggots pose a serious threat in the northern half of Illinois. Maggots infest apples during June, July, and August. For control, a phosphate insecticide is needed every 14 days during this time. Special attention is necessary when an unsprayed host fruit is nearby. Effective traps are now available. They help in timing maggot-control sprays.

Diseases. Fungicides should be continued throughout this period. Rust fungi will continue to infect leaves and fruit through the third-cover stage.

Protection against powdery mildew will be needed into early July. Infection after bloom is mainly on the new shoots. The buds on infected shoots then provide an overwintering place for the mildew fungus.

Other diseases to watch for are late scab, sooty blotch, flyspeck, bitter rot, and Botryosphaeria rot (bot rot). Where bot rot has been a problem, folpet (Phaltan) is suggested as the fungicide to use for the fifth and remaining cover sprays.

Peaches, Nectarines, and Apricots

A specific spray schedule for peaches, nectarines, and apricots is given in the supplement to this circular. The following paragraphs tell what pests to watch for at the different spray periods.

Dormant spray. The pests needing attention during this period are peach leaf curl, scale insects, European red mite eggs, and perennial canker.

The dormant spray is the only chance to prevent peach leaf curl from infecting the new leaves that develop later in the spring. Many fungicides will give control. For curl control, the fungicide must be applied before the leaf buds break.

Oil gives good control of scale insects and European red mite eggs in dormant or delayed dormant sprays up to the pink stage. Both of these pests can seriously damage peach trees. Peaches are more susceptible to damage from oil than are apple trees. Therefore, oil should not be applied when the temperature is likely to drop to 32°F. within 24

hours after application. (See the discussion on using oil and the section on dormant sprays for apples.)

Perennial canker may be partially controlled by using a fungicide immediately after leaf fall. This helps to protect the leaf scars from infection during the late fall. A 4-6-100 bordeaux mixture is suggested, since there is little chance of plant injury at that time. Canker is more serious on some varieties than on others. Rio-Oso-Gem, for example, is more susceptible than Redhaven.

Pink, early bloom, and full-bloom sprays. The pink spray is to control insects such as the tarnished plant bug that cause catfacing. These pests are attracted to open blossoms. They feed on the base of the flower, which causes catfacing, then leave the orchard when bloom is over. Since spraying an insecticide during bloom will kill bees, the pink spray should be applied at least 2 days before the first blossoms open. Bees work the inside of the open flower, which is free from insecticide, whereas catfacing insects work the base of the flower, which is covered with insecticide.

The bloom sprays are for brown rot control. Both ascospores and conidial spores of the brown rot fungus are present for blossom infection. Two sprays are suggested, one in early bloom and one in full bloom.

Oriental fruit moths start emerging during bloom and begin laying eggs before bloom is over. Plum curculio also begin emerging during bloom. Usually, neither insect requires control during the bloom stage.

Petal-fall through cover sprays. *Insects and mites.* Normally, insecticide sprays will be needed every 14 days from petal-fall until after the second brood curculio emerges in early July. After this period insecticides may not be needed.

Stink bugs will be present from late bloom through harvest. They are a major cause of catfacing after bloom. Another cause is punctures caused by curculio feeding and egg-laying. The most serious catfacing injury occurs during bloom through shuck-split. As the fruit grows larger, injury is less severe. Curculio also are a major cause of wormy fruit.

Oriental fruit moth eggs begin hatching near petal-fall time. The first generation feeds inside the tender terminal growth of the new shoots. As the larvae approach maturity, the tips wilt and later die. The number of wilted tips is a good indication of the amount of infestation.

Oriental fruit moths have four generations each year. The second, third, and fourth generations attack the fruit as well as the terminal shoots. The third brood appears in early July along with the second brood of curculio.

San Jose and Forbes scale crawlers begin appearing soon after the second cover spray. Using a magnifying glass and a sharp-pointed knife or needle, check any known scale infestations. If you find any live scales, take special care to thoroughly spray infested areas with an

insecticide, such as parathion or diazinon, which is effective against scale crawlers. Both species have several overlapping generations per year. Once scale crawlers begin appearing, they will continuously increase in number all season if they are not controlled.

Terrapin scale sometimes infests peaches. The adults are brownish insects shaped like a terrapin. A black fungus grows on the drippings (honeydew) that they leave on the branches, foliage, and fruit. During the dormant season, blackened branches are easy to spot. In early June, check infested trees for the presence of small, soft-bodied terrapin scale crawlers on the undersides of the leaves.

Systox, a systemic phosphate, is especially effective against these crawlers because in their early life stages they feed mainly on the leaves. Parathion and diazinon are also effective.

Mites are especially difficult to manage on peaches. They usually do not build up until July or August, when many varieties are ready or almost ready for harvest.

Harvest restrictions seriously limit the choice of miticides. Several miticides are not labeled for peaches at all.

Where red mites were a problem the previous season, an oil spray during the dormant or early growth stage is suggested. And during May and June — red mites and spotted mites must be suppressed and predator mites encouraged. (See the discussion about mites in the section on controlling orchard pests.)

For a discussion of borer control, see the earlier section on apple tree borers and bark beetles.

Diseases. From petal-fall into early July, a fungicide should be applied every 14 days for brown rot and scab control. Sulfur or Benlate is suggested for both diseases during the time that scab-control sprays are needed. The scab fungus has a 45-day incubation period. Thus, regular fungicide sprays are needed up to 40 days before harvest. If not controlled, scab will markedly degrade the fruit.

The first bacterial spot infections may occur during the first-cover period if the weather is warm and rainy. In this event, the Cyprex-captan mixture should be used. Either sulfur or Benlate should be added for scab control.

Preharvest fungicides. During the last 2 weeks before harvest, stone fruits soften and become increasingly susceptible to brown rot. So, it is important to spray a fungicide at frequent intervals prior to harvest.

Determining Peach Insect Populations

Tarnished plant bugs, stink bugs, and curculios migrate into the orchard each year. You can determine their prevalence by making counts on trees in the border rows, starting early in the season. Spread a white cloth under the tree to catch the insects, bump the scaffold limbs sharply with a rubber-cushioned pole, and count the insects immediately after they fall. Do this to the same trees twice a week. Keep a record

of the counts. This will help you compare and evaluate the effectiveness of control measures.

Insect populations can also be estimated by detecting which insects cause the most damage to the fruit. Good places to watch for insect damage during early season include any crab apple, plum, or domesticated cherry fruit that is unsprayed and is close to the orchard.

With a few seasons' practice, you can examine fruit injury during early season in surprisingly little time. By walking through any block or by watching the fruit closely during hand-thinning, you will be able to estimate the populations of pests in your orchard. To determine the times of year when control is weakest, examine a few fruit throughout the block before harvest, or check the types of injury on cull fruit at the grading table.

Virus Diseases of Peaches

Peach yellows, peach rosette, phony peach, and yellow-red virosis are diseases of peaches and other stone fruits that are known to be present in Illinois. The biological agent(s) responsible for these diseases are thought to be viruses, mycoplasmas, or rickettsias.

Since peach yellows is often harbored in the plum, where the symptoms are inconspicuous, wild plums should not be left growing near peach orchards. Yellow-red virosis is primarily a disease of chokecherry, but it may spread to peaches. All chokecherries within half a mile of peach orchards should be destroyed. The common wild black cherry does not carry this virus.

A peach disease known as stem-pitting, which may be caused by a virus, has been found in the eastern states in recent years and was discovered in Illinois in 1969. No vector has been discovered. The stem-pitting symptom occurs below ground level and the disease kills the trees. Remove and destroy such trees immediately.

If you suspect virus diseases, contact the Department of Plant Pathology, N-519 Turner Hall, Urbana, 61801.

Plums

The spray schedule for plums is given in the supplement to this circular. The pests to watch for in the different spray periods are given in the following paragraphs.

Delayed dormant. Plums are subject to rosette and yellows. The only way to control these diseases is to remove all infected trees promptly.

Black knot, a fungus disease, may be controlled by pruning out the knots during two consecutive winters. All twigs with knots should be removed and destroyed. Knots may be cut out of large limbs, thus saving the limbs. It is sometimes helpful to spray as indicated in the

schedule for plums (see the supplement to this circular). Apply fungicides to infected trees as the buds begin to swell.

Use 2 gallons of superior oil for European red mites and scale insects. (See the discussion under peaches.) The scale insects that attack peaches also attack plums.

Petal-fall through second cover. Apply fungicides for control of brown rot and black knot.

Plum curculio is the main insect problem. Curculio feeding greatly increases the danger of brown rot. If no source of reinfestation is near, two or three sprays 7 to 10 days apart will normally give good control. More sprays may be needed, however, if native plums or other host plants are near the orchard.

Additional covers. Brown rot control is most important at this time. Curculio may need control again when the second generation of adults appears. This happens in early July in the southern part of the state. Trees should be examined closely for red mites at about the third cover. Mite control should be the same as suggested for apples.

Cherries

The following paragraphs give general information about pests on cherries. For a specific spray schedule, refer to the supplement to this circular.

Dormant. Scale insects do not often become a problem on cherries. If live scale insects are found, superior oil should be applied. Use 2 gallons per 100 gallons of water, about the time the buds begin growing.

Cover sprays. Immediately after the shucks have fallen, start the cover sprays to control plum curculio and other insects as well as brown rot and leaf spot diseases. Apply a second cover spray 10 days after the first cover. If the weather is wet, continue fungicide applications at 10-day intervals through harvest.

Postharvest sprays. One or two fungicide sprays may be needed immediately following harvest to control leaf spot. For borers, see the discussion in the section on controlling general orchard pests.

Pears

Pears have not been grown extensively in Illinois because of fire blight. However, streptomycin has now been approved for fire-blight control and can be used at 100 ppm up to 30 days before harvest. Although this development is not likely to stimulate a new pear industry, fruit growers may become mindful of pears as a potential source of income. Even with the approved use of streptomycin, one should not plant highly susceptible varieties.

Pear leaf spot and scab can be controlled with a moderate fungicide program.

Pear psylla, the most important insect on pears, has not been a serious problem since the development of organic phosphate insecticides. (See the supplement to this circular.)

GENERAL MANAGEMENT PRACTICES

Tree Nutrition

A great deal of judgment is needed in managing the nutritional status of fruit trees, especially in applying nitrogen. Growth as well as production and fruit quality are useful indicators of nutritional status. The average length of terminal growth on apple trees should be 6 to 10 inches; on peach trees, 12 to 20 inches. If the average does not fall within these ranges, both fertilizing and pruning practices should be modified. Leaf analysis also helps in managing fruit tree nutrition.[1]

Nitrogen. The "rule of thumb" about nitrogen for apple trees is 1 ounce of actual nitrogen (3 ounces of 33-percent ammonium nitrate) per year of tree age up to 1 pound of actual nitrogen per tree. For peaches, the suggestion is 2 ounces of actual nitrogen (6 ounces of 33-percent ammonium nitrate) per year of tree age up to 1 pound of actual nitrogen per tree.

For example, the suggested amount for an 8-year-old apple tree is 8 ounces of actual nitrogen or 24 ounces (1½ pounds) of 33-percent ammonium nitrate; for an 8-year-old peach tree, 16 ounces of actual nitrogen, or 3 pounds (48 ounces) of 33-percent ammonium nitrate.

The amount of nitrogen applied should be adjusted according to the vigor and performance of the tree, the variety, and the amount of pruning. Increase the amount of nitrogen for weak trees and reduce the amount for vigorous trees. Pruning has the same effect as nitrogen fertilization on fruit trees. When heavy pruning is done, reduce the amount of nitrogen applied.

Excess nitrogen increases fruit size, but it delays maturity and seriously reduces color, sugar content, flavor, shelf life, and storage life. Excess nitrogen also increases the amount of pruning required and delays the hardening-off of the trees in the fall, making them more susceptible to winter injury.

A ground application of nitrogen is preferred to foliar feeding. If supplemental nitrogen is needed on red apple varieties, urea may be added to pesticide sprays. Apply during the period from pink to 30 days after petal-fall. Use up to 5 pounds of urea per 100 gallons of water. Do

[1] Leaf samples should be taken between July 15 and August 15. For information about the leaf analysis service, write to the Department of Horticulture, 124 Mumford Hall, Urbana, Illinois 61801.

not use urea on yellow apple varieties, on peaches, or on other stone fruits.

Ground applications of fertilizer may be made in the late fall, or in the early spring 4 to 6 weeks before bloom. Fall application frequently is more convenient because of the crush of pruning and other spring work. Numerous studies indicate little if any difference in effectiveness between fall and spring applications. The roots of fruit trees are active in nutrient absorption whenever the ground is not frozen, even though the tops are dormant.

Phosphorus. During eight years of the leaf-analysis program for commercial orchards, no leaf samples were found to be low or deficient in phosphorus. Illinois soils apparently supply adequate amounts of phosphorus for normal fruit-tree growth without the addition of phosphorus fertilizer. If soil tests show low phosphate levels, the cover crop may need phosphate fertilization.

Potassium. About a third of the leaf samples from commercial peach orchards and about a fourth of the leaf samples from commercial apple orchards have been deficient in potassium.

Harvested fruit removes considerable quantities of potassium. Each 100 bushels of apples or peaches contains about 10 pounds of potassium oxide (K_2O). Prunings also remove sizable amounts of potassium. Therefore, periodic maintenance applications of potassium are advisable.

For peaches, a maintenance application of potassium should be made annually. On soils with low available potassium (below 200 pounds per acre by soil test), apples should also receive an annual maintenance application. If the soil has more than 200 pounds of potassium per acre, apples should receive maintenance amounts every other year. Check the nutrition conditions by leaf analyses.

Potassium should be applied to the soil rather than the leaves, since the leaves do not absorb appreciable quantities of this nutrient. Either muriate of potash (0-0-60) or sulfate of potash (0-0-50) may be used. Potassium may also be applied in mixed fertilizers if the rates are adjusted to apply amounts equivalent to the rates suggested.

A general suggestion for apples is 1 pound of muriate or sulfate of potash per tree for young trees, 2 pounds per tree for dwarf or semi-dwarf trees in full production, and 4 pounds per tree for standard trees in full production. For broadcast applications, use 150 to 200 pounds per acre.

For peaches, apply 1 pound of muriate or sulfate of potash per tree for young trees and 2 pounds per tree for trees in full production; or, apply 150 to 200 pounds per acre broadcast.

Boron is the minor element most likely to become low in Illinois apple orchards. So far, leaf analyses do not indicate a shortage of boron on peaches in Illinois.

Boron is most conveniently applied to apple trees as a foliage spray.

Boron is essential for pollen germination; therefore, the first application should be in the pink stage. Add 1 pound of Solubor per 100 gallons of water (2 pounds per acre for low-volume sprays) to the pink spray, and again in the petal-fall spray. Do not exceed this amount. Excess boron can be toxic. Do not mix Solubor with calcium chloride.

Calcium. Low levels of calcium in the leaves and fruit of apple trees are associated with the physiological disorders bitter pit and Jonathan spot. Although low levels of calcium are not considered to be the cause of these disorders, their severity is frequently reduced by increasing the calcium levels of the leaves and fruit.

Foliar feeding with calcium chloride is suggested for Red Delicious and Jonathan, the varieties most subject to corking disorders in Illinois. Starting with the first-cover spray, add calcium chloride at the rate of 2 pounds per 100 gallons of dilute spray (4 pounds per acre for low-volume spray) until late July. Then increase the calcium chloride rate to 3 pounds per 100 gallons of dilute spray (6 pounds per acre for low-volume spray) for the later cover sprays.

During prolonged drouths, eliminate calcium chloride applications to prevent an excessive buildup on the foliage which may cause leaf burn. Increasing the calcium chloride application rate just before harvest helps to prolong the shelf life and storage life of the fruit.

Adding calcium chloride to the regular insecticide and fungicide sprays should have no effect on the action of these materials. Likewise, the addition of calcium chloride to the regular sprays should have no adverse effect on the fruit finish of red-skinned varieties.

No adverse effect from calcium chloride sprays has been noted on the finish of Golden Delicious. However, since fruit finish is a perennial problem with Golden Delicious and since bitter pit is not usually a problem, applying calcium chloride to Golden Delicious is not suggested until we have more experience. Calcium chloride is used in tractor-tire solutions. One supply source would be farm implement dealers.

Soil reaction (pH) affects fruit trees indirectly through its effects on the availability of several soil nutrients. In strongly acid soils (a pH below 5.0), the availability of phosphorus is reduced and the solubility of iron, aluminum, and manganese is increased so much that they may become toxic to plants. The pH of orchard soil should be kept in the 5.5-to-7.0 range through applications of agricultural lime.

Spray materials and fertilizers applied to fruit trees may cause the soil under the trees to become more acid. In testing for pH it is advisable to test samples taken under the trees separately from samples taken from the aisles. The soil under the trees may be more acid and thus may require more lime than that in the aisles.

Young apple trees sometimes develop a condition called "measles" (internal bark necrosis) when the soil pH is 5.5 or below. Red Delicious

trees are especially susceptible. Some growers have prevented or reduced the symptoms of measles by watering each tree with 5 gallons of a solution of 40 pounds of hydrated lime in 100 gallons of water.

Chemical Fruit Thinning of Apples

Chemical fruit thinning of apples enables growers to overcome the alternate bearing habits of some varieties and to improve the size and quality of the fruit in years of heavy set. The materials suggested are NAA (naphthaleneacetic acid), Amid-Thin (naphthaleneacetamide), and Sevin. Suggested materials and dosages for the different varieties are given in the accompanying table.

On Lodi, Wealthy, Melba, and Transparent, a combination of NAA and Sevin applied at petal-fall usually gives better results than either material alone. On Golden Delicious some growers have had good results with the combination of NAA and Sevin applied at the normal time for applying NAA on Goldens.

On Starkrimson and other spur-type Red Delicious strains, NAA has occasionally caused problems with pigmy fruit. Instead of dropping off, these seedless pigmy fruit remain on the tree until harvest, growing to about one-fourth normal size. Where pigmy fruit presents a problem, Sevin should be used for thinning.

When NAA is the only thinning agent applied, its absorption and effectiveness are greatly increased by use of the activators Tween 20 and Regulaid. The concentration of NAA can roughly be cut in half if Tween 20 or Regulaid is used. These activators help to counteract the variable effects of weather conditions on the absorption of NAA. Thinning actions thus become uniform and reliable, and the danger of overthinning is reduced. Tween 20 and Regulaid have little, if any, effect on the absorption and effectiveness of Amid-Thin and Sevin.

Because of variable growing conditions, NAA sprays are timed according to fruit size rather than days after full bloom. NAA is most effective on fall and winter varieties when most of the fruits are 8 to 10 millimeters in diameter, the king blossom fruit is 10 to 13 millimeters, and the smallest fruits are less than 8 millimeters.

Fruits should be measured either early in the morning or late in the evening. They tend to shrink during the day and to grow at night. Starting a few days after petal-fall, select a measuring time, measure fruits every day at the same time, and record the results. Measure each variety separately.

Apply thinning sprays separately from other sprays. Use dilute concentrations with full coverage of the tree parts to be thinned. Low-volume application involves more risk. Growers having low-volume spraying equipment only should use the highest volume possible with these machines.

SUGGESTED THINNING SPRAYS FOR DIFFERENT APPLE VARIETIES

Variety	Materials	Timing
Lodi Melba Transparent Wealthy	NAA, 10 ppm —plus— Sevin 50W, 2 lb. per 100 gal.	At petal-fall
Duchess McIntosh Jonathan Lodi Summer varieties not listed elsewhere	Amid-Thin, 50 ppm	
Golden Delicious Rome Beauty	NAA, 8.75 to 11.25 ppm —plus— Tween 20, or Regulaid 1 pt. per 100 gal.	When king fruit is 10 to 13 mm. in diameter
Jonathan McIntosh Red Delicious* Turley Grimes Golden	NAA 3.75 to 6.25 ppm —plus— Tween 20, or Regulaid 1 pt. per 100 gal.	
Red Delicious*	Sevin 50W, 1 to 2 lb. per 100 gal.	18-21 days after full bloom

* Red Delicious includes red sports and spur types but does *not* include Summer Delicious.

NAA usually gives the most reliable results when the temperature is between 70° and 75°F. and drying conditions are good. Amid-Thin, in contrast, gives best results under slow drying conditions (on damp, cloudy days, at dusk, or at night).

Frost or freezing temperatures injure apple leaves and cause them to absorb thinning chemicals more readily. Overthinning may result. If fruit needs thinning soon after a frost or if the leaves show visible damage (such as crinkling or distortion) from an earlier frost, reduce concentrations by 25 percent.

Old trees are harder to thin than young ones. Vigorous trees are harder to thin than weak or low-vigor trees of the same age. The greater the number of seeds set per fruit, the more resistant the apples are to thinning chemicals. The suggestions in this section are for trees in an average and desirable condition with adequate pollination and seed set. You should modify the suggested concentrations to fit conditions in your orchard.

Since tree and pollination conditions do vary among orchards, among blocks within an orchard, and from year to year, you should keep detailed records of thinning operations and their results. These data provide the most accurate information for making intelligent decisions about chemical thinning.

Thinning Peaches

Under Illinois conditions, mechanical methods are suggested for thinning peaches. CPA (3 chlorophenoxy alpha-propionamide) is registered for thinning peaches, but field tests with CPA in Illinois have not given desirable results.

Peach fruits go through a stage just before pit-hardening when they are held on the tree loosely and can be jarred from the tree easily. Fruits tighten when the pits start to harden. Thinning should be done during the "loose" period.

The loose period usually starts 1 or 2 weeks after shuck-off or about 5 or 6 weeks after full bloom, depending on weather conditions. It does not last very long, so you should be ready to concentrate on thinning operations when it develops.

To find the start of the loose period, jar a few branches every 2 or 3 days starting a week after shuck-off. Strike small branches (about ½ inch in diameter) a sharp blow with the heel of the hand or with a short piece of stiff rubber hose. When some of the peaches fall readily, they are loose and ready for mechanical thinning.

Mechanical equipment. The largest and fastest machine for mechanical thinning is the trunk-shaker mounted on a tractor. Experienced operators can shake more than one tree a minute with this machine. But trunk-shakers may damage the bark on the trunk if they are not properly adjusted and skillfully operated.

Branch-shakers utilizing either pneumatic or hydraulic power are available from several manufacturers. These units are attached to a power source and are positioned near the branches by the operator.

The "Kentucky bumper" is a sturdy 3½-foot pole with one end heavily padded. Branches are struck a sharp blow with the padded end. Branches up to 2½ inches in diameter can be thinned with the Kentucky bumper.

A pole-thinner can be made by attaching a 15- to 18-inch piece of stiff rubber hose to one end of a 4- to 7-foot long lightweight pole such as a broom or hoe handle. The pole-thinner works best on small branches. When the branches are willowy and drooping, clusters of fruit can be thinned with light blows on the clusters.

The trunk-shaker, branch-shaker, and Kentucky bumper remove the most fruit in the least amount of time. However, they do not do a completely uniform job. They will adequately thin the stiffer branches but may not thin the willowy ones. Touch-up thinning with poles is needed, therefore, but this goes much faster than pole-thinning the entire tree.

Thinning by hand. Fruit can be thinned by hand up to harvest time. But hand-thinning requires so much labor it should be used only in emergency situations or as a final touch-up after earlier thinning methods have been used.

Spacing. A general rule in thinning is to remove fruit until the remaining peaches are an *average* of 5 to 7 inches apart. Varieties that mature early usually need more severe thinning than later varieties in order to obtain adequate size at harvest.

Bringing Young Apple Trees Into Bearing

With normal care, young dwarf and semi-dwarf apple trees should begin to bear commercially profitable crops in their fourth or fifth year. Standard trees require a longer period. Golden Delicious and Jonathan trees usually start bearing without any special treatments. Red Delicious trees are vigorous growers, so they frequently need encouragement to initiate bearing. One or more of the following measures are suggested.

1. **Stop fertilizing applications** to help slow down growth.
2. **Use branch spreaders** to position branches into a 45° angle growth pattern (Fig. 1).
3. **Score the trunk** 3 to 6 weeks after the normal bloom date. Using a sharp knife, cut through the inner bark completely around the tree just below the lowest branch. Make a clean, smooth cut and do not loosen the bark at the edges of the cut (Fig. 2).

A combination of the growth regulators Alar and Ethrel helps in slowing down terminal growth and in setting fruit buds for the following season. Apply 1 pound of Alar plus 1 pint of Ethrel per 100 gallons of water 4 to 5 weeks after the normal bloom date. Cover all foliage thoroughly.

Preventing Premature Bearing

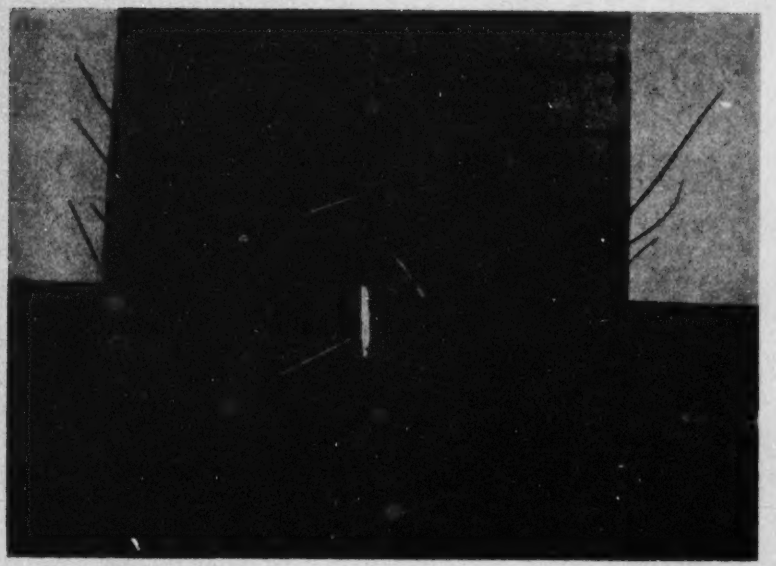
Young Golden Delicious and Jonathan trees sometimes set fruit before they are large enough to produce profitable crops. This premature fruiting should be prevented because it reduces tree growth. The general rule is that 2 pounds of apples reduce total shoot growth about 3 feet.

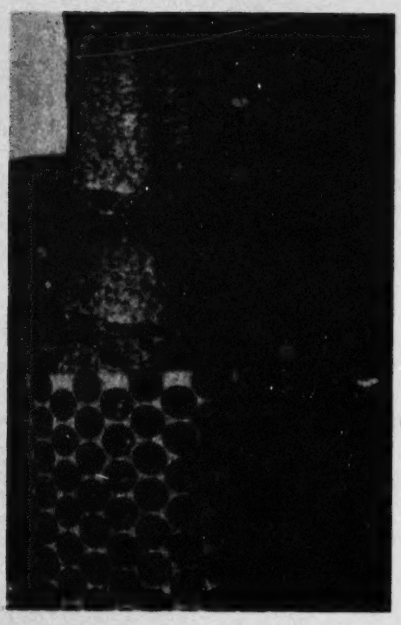
Spray with 2 pounds of Sevin per 100 gallons of water at petal-fall, or remove the apples by hand.

Preventing a Preharvest Drop of Apples

The onset of preharvest apple-drop is affected by the crop size, soil moisture, temperatures, and damage to the leaves caused by mites. Under average conditions, the drop usually starts 7 to 10 days before the normal harvest date. The drop may occur earlier when the weather is hot and dry, when the leaves are damaged by mites, and when the trees are weak or have a heavy crop.

Chemical growth regulators effectively reduce preharvest drop on healthy trees, permitting greater flexibility in harvest operations and





Above. A 3-year-old, spur-type Red Delicious on seedling roots, after spreading and pruning. Spreading the branches improves tree shape, reduces the amount of pruning needed, and encourages early bearing. The spreaders are 1- by 1-inch hardwood of varying lengths with sharpened nails in each end. (Fig. 1)

Left. Trunks of vigorously growing young trees which are tardy in bearing may be scored to induce flower formation. Scoring is most effective if done about 3 weeks after full bloom, but it will give some results if done as late as 6 weeks after bloom. Both scoring wounds on this young Delicious tree have healed. The lower wound is about 2 years old. The tree effectively initiated bloom the following spring, but frost killed the flowers. The tree was scored again about 3 weeks after bloom, so the upper wound is about a year old. (Fig. 2)

usually improving the appearance and quality of the fruit. None of the materials is effective on weak trees or ones affected by mites or drouth.

NAA (naphthaleneacetic acid) takes effect in 2 to 4 days and is effective for about 7 to 10 days. Use 10 ppm for summer varieties, 15 ppm for fall varieties, and 20 ppm for winter varieties. Two applications are authorized, if needed. If applied according to directions, NAA should not hasten maturity.

2,4,5-TP [2-(2,4,5-trichlorophenoxy)propionic acid] takes effect in about 7 days and is effective for about 20 days. It may accelerate ripening if applied too early or if the weather is hot. Do *not* apply on summer varieties or on Grimes Golden. Do *not* use more than one application of 10 ppm on Golden Delicious. 2,4,5-TP is most useful on fall and winter red-fruited varieties. Use 10 to 15 ppm on Jonathan and Red Delicious and 20 ppm on Winesap and Rome Beauty.

A combination of 10 ppm of NAA and 10 ppm of 2,4,5-TP has given both quick and long-lasting effects on fall varieties without appreciably modifying maturity.

Alar (succinic acid 2,2-dimethyl hydrazide) has the longest drop-preventive effect. One application of 1,000 ppm 60 to 85 days before normal harvest date will usually hold the fruits of red fall and winter varieties on the tree. In a few instances, however, Alar has not given adequate drop control. If Alar-treated apples start to loosen, either NAA or 2,4,5-TP may be applied.

For McIntosh, Alar is the most effective material available. Alar is *not* suggested for varieties ripening before McIntosh. Nor is it suggested for Golden Delicious or Grimes Golden because of the danger of uneven color development.

Do not use Alar on weak trees or on trees that are low in vigor. Late application of Alar may result in excessive carryover effects the following season. This may cause Red Delicious fruit to become more flattened in shape.

Besides acting as a stop-drop, Alar delays maturity about 5 days, increases red color and firmness, and increases storage life. Its use on red varieties going into storage is suggested since an early harvest date is not important.

Apply preharvest drop-preventive sprays separately from other sprays. Dilute sprays with full wetting are suggested, but concentrate sprays can be successful if the amount of material applied is correctly calibrated. Apply when the temperature is between 65° and 75°F. and when rain is not expected for 12 hours.

Delaying Apple Maturity

The growth regulator, Alar, delays apple maturity about 5 days, increases flesh firmness, increases red skin color, delays water core development, increases storage life, prevents preharvest drop, and re-

duces fruit size slightly. Treating a portion of the planting of a variety with Alar extends the harvest season for that variety. Alar treatment is suggested for apples to be held in cold storage more than 90 days.

Alar is especially helpful on Starking and other moderate-coloring Red Delicious strains. The delay in maturity enables them to develop more color.

As already indicated, apply Alar 60 to 85 days before the normal harvest date for the variety treated and when there will be no rain for 12 hours following application. Cover the trees thoroughly. Do not mix with pesticides or fungicides. Use either ¾ pound of Alar alone per 100 gallons (2½ pounds per acre) or ½ pound of Alar plus 1 pint of Regulaid per 100 gallons of water (1¾ pounds of Alar plus 2 pints of Regulaid per acre). For low-volume application, use at least 100 gallons per acre. Do not apply Alar to trees low in vigor, ones under moisture stress due to drouth, or ones suffering from mite damage.

Advancing Apple Maturity

The growth regulator, Ethrel, advances maturity, ripening, and the development of a red skin color. Ethrel also promotes uniform ripening, enabling once-over harvest. Treating a portion of the planting of a variety extends the harvest season for that variety.

In Illinois, Ethrel is most useful on Jonathan and the high-color, spur-type sports of Red Delicious. Ethrel is not suggested for Golden Delicious and Starking. It causes blotchy ripening on Golden Delicious. It advances maturity on Starking; but the color development is disappointing, resulting in poorly colored fruit.

The combination of Alar applied 60 to 85 days before the normal harvest date and Ethrel applied later works well. Alar counteracts some of the softening effects of Ethrel, with little or no effect on the coloring and ripening abilities.

Use Ethrel on apples to be harvested for the early market only. Do not use Ethrel on apples that will be going into cold storage.

Program the Ethrel application to fit marketing needs and harvesting and packing abilities. On a given day, do not treat more fruit than can be harvested, packed, and shipped in a 2-day period. Treat other batches of trees at 2- or 3-day intervals. Observe the treated fruit daily in order to determine when the fruit is ready to pick. The ideal picking stage is shorter for treated versus untreated fruit, and the treated fruit will become over-ripe more quickly.

Ethrel's effectiveness depends on weather conditions. It works best when the days are warm and sunny (75° to 90°F.) and the nights are cool (55° to 68°F.). Ethrel is less effective when daytime temperatures are above 90°F. or when the temperatures at night are above 68°F. When the weather is hot or when hot weather is predicted, delay applying Ethrel until the weather turns cooler.

Ethrel requires 7 to 14 days to ripen and color apples. The closer the apples are to normal ripening, the shorter the time required. If desired for marketing purposes and if weather conditions are suitable, Ethrel may be applied up to 3 weeks prior to the date when color-picking untreated trees of the same variety would start.

Ethrel will cause the apples to loosen and drop. Therefore, drop-preventive materials must be applied with Ethrel. Previously applied Alar will not prevent the loosening effects of Ethrel.

On Jonathan and the high-color, spur-type sports of Red Delicious, use 1 pint of Ethrel plus 10 ppm of NAA plus 10 ppm of 2,4,5-TP (Fruitone T, Color-set) per 100 gallons of water. Cover the trees thoroughly when there will be no rain within 12 hours and when the temperature is above 50°F.

Advancing Peach Maturity

Alar advances the maturity of peaches and promotes more of a uniform ripening, thus requiring fewer pickings. Alar is most effective on varieties ripening with or after Redhaven. The harvest season for a variety can be lengthened by treating a portion of the planting of that variety.

Alar advances the maturity of Redhaven 2 or 3 days. The maturity of Redskin and other later varieties is advanced 4 or 5 days. Alar does not affect the size, color, or quality of the fruit.

Apply Alar just before pit-hardening, when the peaches are loose and ready for pole-thinning. Use 1½ to 2 pounds of Alar per 100 gallons of water as a dilute spray.

Fully wet the trees until they drip. Do not use concentrated sprays. Apply when there will be no rain for 12 hours following the treatment.

Apple Scald and Its Control

Scald is a noninfectious, physiological disease that develops in apples during storage. It is very difficult to cope with, since we do not know its exact nature. Apples picked when they are too immature and put into cold storage may — or may not — develop scald.

Another potential cause of scald is cooling apples too rapidly when they are first put into cold storage. Scald may also develop if storage temperatures should accidentally drop below 28°F., even for a short time.

DPA (diphenylamine) and ethoxyquin are available for scald control. Apply as a *postharvest* dip, spray, or drench before placing the fruit into cold storage. These materials may not be effective under abnormal conditions; therefore, the utmost care should be observed in maintaining ideal picking, handling, and storage conditions.

ORCHARD CHEMICALS

The United States Environmental Protection Agency classifies pesticides and the uses of pesticides as general-use or restricted-use under the requirements of the Federal Environmental Pesticide Control Act of 1972. Growers wishing to apply restricted-use pesticides on their plantings must obtain a permit as a "certified private applicator." For information about the certification program, contact your County Cooperative Extension Service Office.

Chemical Formulations

Agricultural chemicals are formulated in many different ways, depending on their intended use. Package labels are a most valuable source of information about the chemicals. Labels should always be read carefully before the chemical is used. The most important chemical formulations are described below.

Wettable powders are the most commonly used formulations for control of orchard pests. The active ingredient in wettable powders may be either soluble or suspendible in water and may vary in amount from 15 to 95 percent, depending on the chemical involved.

Parathion, for example, is a 15-percent wettable powder and sulfur is usually about 95-percent active. How much formulation to apply depends on the amount of active ingredient.

Some chemicals are prepared for use as "water-flowable" or "aqua" formulations. They are sometimes called slurries or pastes. Such formulations generally give excellent control of pests. They may be 50-percent active in water and they suspend well. Unless they dry out before they are used, they handle easily. If they do become dry, they are difficult to rewet.

Emulsifiable concentrates are formulated by dissolving a chemical in either an oil- or alcohol-base solvent and conditioning the solution to form an emulsion with water. Emulsifiable concentrates are usually more economical to use than wettable powders per unit volume of chemical. When these formulations are added to other chemicals, compatibility problems may be increased.

Granular preparations are mainly used for controlling soil pests. These preparations are not used in sprays.

Dust formulations are of many types. Most of the common insecticides and fungicides have been prepared as dusts. Some preparations contain both an insecticide and a fungicide. Dusts are to be applied only in the dry form because they are not wettable.

Microcapsules are a newer type of preparation. Insecticides are put into capsules and formulated as slurries or water suspensions. The capsules reduce the use hazard by coating the chemicals. The chemicals

are released from the capsules slowly, which extends the effectiveness but does not change the harvest restrictions.

Flowables are finely ground, wettable-powder formulations sold as thick suspensions in a liquid carrier to facilitate their addition to the spray tank.

Soluble powders are dry formulations that dissolve when added to water, forming true solutions.

Fungicides and Bactericides

Benlate (50-percent benomyl) is formulated as a 50-percent wettable powder. A fungicide with a wide range of fungus toxicity, it is both protective and curative in action. Benlate is most effective against apple scab, powdery mildew, and many of the summer diseases. It is not effective against the apple rust diseases.

Benlate-resistant strains of the apple scab fungus have been reported wherever this fungicide has been used as the major fungicide for more than two years.

Benlate is compatible with oil. Excellent disease control and mite suppression have resulted from the use of 2 ounces of Benlate with 1 quart of superior oil per 100 gallons. Benlate alone also gives some mite suppression.

Benlate is extremely effective against brown rot and peach scab of stone fruits. It has full approval for use on stone fruits, and can be used in postharvest dips at the rate of 8 ounces per 100 gallons.

Bordeaux mixture is a combination of copper sulfate, hydrated lime, and water. A 4-6-100 bordeaux mixture consists of 4 pounds of copper sulfate, 6 pounds of lime, and 100 gallons of water. Various strengths of a bordeaux mixture can be used, depending on the need. A weak bordeaux mixture — such as ½-1-100 or ¼-½-100 — can be used for blossom blight on Jonathans. But even this weak mixture may cause severe russet, and it may not be too effective against fire blight.

As a dormant spray, the copper sulfate may be used at 4 pounds per 100 gallons. As a delayed-dormant treatment, an 8-8-100 bordeaux mixture is suggested. A 4-6-100 bordeaux mixture can be used on peaches for peach leaf curl. A treatment of copper sulfate, 4 pounds, followed immediately by 6 pounds of hydrated lime is suggested on peaches about October 15 in southern Illinois to reduce the carryover of the bacterium that causes bacterial leaf spot. Sometimes this treatment is effective and sometimes not, depending on the weather in the spring. If you have a serious infection and become desperate, you may want to try this program.

Botran (DCNA, dicloran) is formulated as wettable powders and dusts. It may be incorporated into fruit waxes and fruit wraps. Botran is recommended for the control of Rhizopus rot and is also moderately

effective against brown rot. It can be applied either pre or postharvest on many stone fruits.

Captan is available for orchards as a 50-percent wettable powder. The full-strength rate is 2 pounds in 100 gallons of water. It is also formulated as a 7½-percent dust.

Captan causes a minimum of plant injury and is especially favored for use on russet-susceptible apple varieties such as Golden Delicious. It is effective against a large number of apple diseases including scab, flyspeck, sooty blotch, bitter rot, and Botryosphaeria, but will not control powdery mildew or rusts. Captan has been used for years against brown rot disease on stone fruits. It is compatible with all pesticides except those that are alkaline and oily. (Do not use captan with oil or apply immediately after an oil spray. Do not apply oil on a captan residue.)

Cyprex (dodine) is formulated as a 65-percent wettable powder. For full strength, it is recommended at ½ pound in 100 gallons. If a serious scab epidemic is not expected, ⅜ pound in 100 gallons is adequate. Cyprex is most effective against apple scab and cherry leaf spot, and can both eradicate and prevent these diseases. The material is also used with captan to reduce bacterial spot on peaches.

Cyprex is compatible with all pesticides except alkaline materials such as lime. It is now commonly used with oil in a delayed dormant spray. However, cyprex-oil mixtures are not compatible with wettable-powder formulations of ferbam, malathion, Sevin, zineb, captan, or sulfur.

Do not use more than 0.325 pound of actual ingredient in 100 gallons of water immediately before, during, or immediately after freezing or near-freezing temperatures. Low-volume sprays higher than 5X are not suggested. Peaches have been injured from combinations of Cyprex, captan, and emulsifiable-concentrate insecticides.

Cyprex-resistant strains of the apple scab fungus have been reported in orchards which have relied solely on the use of this fungicide for scab control.

Difolatan (captafol) is formulated as a 39-percent flowable suspension containing 4 pounds of active ingredient per gallon. Its sole use is as a single-application technique (SAT) for apple scab control. One application of 5 quarts per 100 gallons during the late-dormant through green-tip growth stages can be expected to control scab in a year of normal rainfall through the bloom stage. A lower rate (3 quarts per 100 gallons) can be used on varieties that are susceptible to rust. This reduced rate will control scab until the pink-bud stage, when rust fungicides must be applied. Scab control must be resumed with another fungicide at the pink or petal-fall stage, depending on the SAT rate used. Difolatan must *not* be used after the green-tip stage, since severe phytotoxicity can occur.

Difolatan is very irritating to the skin and eyes of some people.

Working in sprayed areas even several days after application is not recommended. Difolatan is compatible with oil.

Dikar is a fungicide that contains Karathane and a maneb-zinc ion complex (Dithane M-45). Dikar is used at 2 pounds in 100 gallons. At this concentration, Dikar contains the equivalent of ½ pound of Karathane and 1½ pounds of Dithane M-45. It has been designed as an all-purpose fungicide and is effective against all of the important apple orchard fungus diseases, including powdery mildew, apple scab, quince and cedar-apple rusts, and frog-eye leaf spot. Dikar is also a mite-suppressant, and does not russet Golden Delicious.

Ferbam is a protective fungicide marketed as a 76-percent wettable powder. The recommended use rate is 2 pounds in 100 gallons. Ferbam is particularly effective against cedar-apple rust, quince rust, and apple blotch. It is compatible with all orchard sprays except those containing lime and copper. It is synergistic with sulfur — that is, the two materials enhance each other's effectiveness. Ferbam is considered toxic to some russet-susceptible varieties.

Glyodin is a liquid protectant fungicide. When used alone, the rate is 1 quart in 100 gallons. It is effective against apple scab, sooty blotch, and flyspeck. Glyodin also suppresses red mites. Because of glyodin's excellent wetting and sticking properties, it is frequently combined with other fungicides and insecticides. When glyodin is used in this way, the rate is 1 pint in 100 gallons. Glyodin is compatible with all common orchard insecticides and fungicides, and has been found to increase the effectiveness of some materials such as captan, Benlate, and streptomycin.

Karathane (dinocap) is a 25-percent active wettable powder used for powdery mildew control at the rate of ½ pound in 100 gallons of water. Karathane is used primarily in the summer when sulfur is likely to be toxic to the trees in the orchard.

Lime sulfur is an eradicant and protectant fungicide available in both liquid and dry form. The liquid form is recommended at 2 gallons in 100 gallons of water, and the dry form at 8 pounds in 100 gallons. Because lime sulfur can damage trees, its use has steadily declined in the last 25 years. However, a number of growers still use lime sulfur on apples in the prepink spray, since it is relatively inexpensive and is effective against apple scab.

Phaltan (folpet) is a 50-percent wettable powder that is used at the rate of 2 pounds of formulation in 100 gallons. Chemically it is closely related to captan but is slightly more toxic both to fungi and to plants. Phaltan will defoliate peaches at 2 pounds of formulation in 100 gallons. Its effectiveness in controlling Botryosphaeria rot on apple has brought it notice. Where this disease is a problem, Phaltan is suggested in the fifth and succeeding cover sprays. Phaltan used at that time of year will not injure the fruit.

Phygon (dichlone) when marketed as a 50-percent wettable powder should be used at ¼ pound in 100 gallons. It is also available as a sulfur-dichlone wettable powder and as a 7½-percent dust. Phygon is excellent for inhibiting the germination of fungus spores but has little residual effect. At 90° F. or above, Phygon may be toxic to plants. In Illinois, it is used mainly to control brown rot blossom blight on peaches. Phygon is very effective for this purpose. Some growers have found a sulfur-dichlone dust effective as a supplement to the regular apple scab spray early in the spring.

Polyram is a fungicide with a wide spectrum of activity against many fungal diseases. It effectively controls apple scab, blotch, the rusts, sooty blotch, flyspeck, bitter rot, and the like. Polyram is an 80-percent wettable powder of polyethylene polymer. It is used at 2 pounds in 100 gallons of water early in the season, and at 1½ pounds in the cover sprays. Polyram has given excellent finish on Golden Delicious. It will not control powdery mildew.

Streptomycin is available in different powder formulations. It is the only effective treatment for the fire blight disease on apple and pear trees. Streptomycin can be used up to 100 ppm, and can be applied to within 50 days of harvest. Streptomycin should not be combined with other materials. It works very well in low-volume sprays. Streptomycin has been effectively applied with overhead irrigation sprinklers.

Sulfur, a protectant fungicide, is available as a microfine, wettable powder. When sulfur is used alone, the recommended rate is 6 to 8 pounds in 100 gallons of water. Sulfur is now recommended at half strength (3 to 4 pounds in 100 gallons) in combination with a half-strength formulation of organic fungicides. This combination is very effective against apple scab and also gives protection against powdery mildew infection. As the weather gets warm, sulfur should be omitted from the spray. If powdery mildew control is still needed, other materials should be used.

Sulfur is the mainstay in the control of peach diseases, and is recommended throughout the season except just before harvest. Sulfur is especially important in the early cover sprays to control peach scab.

Thiram is formulated as a 65-percent wettable powder, recommended at 2 pounds in 100 gallons. This protectant fungicide is effective against many diseases, such as apple scab, apple blotch, and cedar-apple and quince rusts. Thiram may also reduce Botryosphaeria infections. It gives excellent finish on russet-susceptible varieties such as Golden Delicious. Thiram is compatible with all of the common fungicides and insecticides.

Zineb, a protective fungicide, is usually formulated as a 75-percent wettable powder. The recommended rate is 2 pounds in 100 gallons of water. Zineb is effective for the rust diseases and many of the summer diseases on apple trees, such as black rot, sooty blotch, and

flyspeck. Zineb plus captan, each at half strength, is a popular apple orchard fungicide. Since zineb is compatible with most orchard chemicals, it may be used almost anywhere in the apple spray schedule. On peaches, zineb helps control bacterial spot.

The effectiveness of fungicides and bactericides against common orchard diseases is given in tabular form at the end of this circular. Always read the labels carefully.

Insecticides and Miticides

The persistence of the compounds listed in this section is given by these categories:

	No. of days
Very short	Less than 2
Short	2 to 4
Moderate	4 to 8
Long	8 to 12
Very long	More than 12

Nonsystemic Insecticides

Diazinon, an organic phosphate, is formulated as a 50-percent wettable powder for fruit. This moderately long-lasting chemical controls a very wide range of pests. Diazinon is useful on apples for codling moth, aphids, and scale insects. It is weak against red-banded leaf roller and apple maggots. The use hazard and persistence are moderate.

Guthion (azinphos methyl) is an organic phosphate which is formulated as a 50-percent wettable powder for orchard use. It has given outstanding control on most fruit pests, and acceptable control on nearly all the others. Guthion is weak against San Jose scale. Mite pests, however, have become strongly resistant where Guthion has been used for several seasons, and predatory mites are also resistant. Guthion is slow-acting on tarnished plant bugs and should be applied 2 days before bloom on peaches. Guthion's residual toxicity is long. The use hazard is moderate.

Imidan (phosmet), an organic phosphate, is a broad-spectrum insecticide for use on apples, pears, and peaches. It is formulated as a 50-percent wettable powder. The dosage rate is 1 to 1½ pounds of the 50W formulation. The high rate is suggested for plum curculio. Imidan is weak against red-banded leaf roller and San Jose scale. Imidan has a low use hazard and a long residual effect.

Lannate (methomyl) is formulated as a water-miscible liquid containing 1.8 pounds of active ingredient per gallon. It is a carbamate-type insecticide that is effective against aphids, caterpillars (such as codling moth and Oriental fruit moth), and leafhoppers. Lannate is similar to Sevin, and is toxic to bees and predatory mites. Lannate's persistence and use hazard are both moderate.

Lorsban (chlorpyrifos) is an organic phosphate, with 4 pounds per gallon of emulsifiable concentrate. It is very effective against peach tree borers, and has an unusually long-lasting residual effectiveness on the bark. The use hazard is moderate.

Malathion, an organic phosphate, is formulated as a 25-percent wettable powder and as several emulsifiable concentrates. Because malathion is effective against a wide range of insect pests, it has been successfully used alone in apple spray programs. It is weak against high populations of curculio and red-banded leaf roller. Malathion is short-lasting and has a very low use hazard.

Mesurol (methiocarb) is a carbamate insecticide formulated as a 75-percent wettable powder. It is registered on peaches and cherries for plum curculio control. When applied for curculio, Mesurol repels birds effectively and kills predator mites. The use hazard is moderate and the residual effect is long.

Parathion, an organic phosphate, is formulated as 15-percent and 25-percent wettable powders and in several liquid concentrations. Parathion has been used for many years on fruits, where it is still effective against most insects. Parathion is the most effective insecticide against San Jose scale during the growing season. It has a short residual effect and a very high use hazard. A formulation in microcapsules reduces the use hazard and lengthens the effective period against insects. Parathion may russet apples in the early season.

Phosdrin (mevinphos) is formulated as an emulsifiable concentrate, with 2 pounds of active ingredient per gallon. It is effective against a wide range of pests, including mobile mites and all stages of the red-banded leaf roller. The residual effect is very short — 1 to 3 hours. The use hazard is high. This chemical is useful, therefore, when high populations of pests must be controlled immediately before or during harvest.

Sevin (carbaryl) is a carbamate that is effective against a wide range of insects. It is especially effective against periodical cicada. One pound of 50-percent wettable powder in 100 gallons of water controls codling moths and green aphids. Two pounds are required for most other insects. When Sevin is used in a series of sprays, a miticide should also be used, since high mite populations often accompany its uses. To avoid thinning apples, do not apply Sevin until 25 days after bloom. The hazard is low and the persistence is long.

Thiodan (endosulfan), a chlorinated hydrocarbon containing sulfur, is formulated as a 50-percent wettable powder or as an emulsifiable concentrate with 2 pounds of active ingredient per gallon. It gives outstanding control of peach tree borers and will also control aphids, spittlebugs, and stink bugs. The material is persistent and has a moderate use hazard.

Trithion (carbophenothion), an organic phosphate, is formulated as a 25-percent wettable powder and as several liquid concentrates.

It has given good control of aphids and mites; but wherever it has been used for any length of time, mites show strong resistance. Trithion is a moderately long-lasting compound, and has a high use hazard.

Zolone (phosalone), an organic phosphate, is formulated as an emulsifiable concentrate at 3 pounds per gallon and as a 25-percent wettable powder. Zolone is effective against a wide range of fruit pests, but it may be weak against high plum curculio populations. It provides control of red mites when first used, but also kills predatory mites. The use hazard is moderate. The persistence is long.

Systemic insecticides

These are all organic phosphates and are absorbed into the leaves, moving through the plant with the water in the plant. Systemic materials are absorbed most efficiently by young tissue and should be applied only in early season. They are effective against sucking insects and are moderately effective against some chewing insects that feed on rapidly growing tissue. Control of aphids is particularly outstanding and does not depend on good coverage.

Cygon (dimethoate) is formulated as an emulsifiable concentrate with 2.67 pounds of active ingredient per gallon and as a wettable powder. Cygon is absorbed very quickly into leaf tissue and is moderately effective against codling moth, curculio, and mites. It is very effective against aphids. Although the use hazard is low, the chemical has a strong odor. The residual effect is short.

Phosphamidon is formulated as an emulsifiable concentrate containing 4 or 8 pounds of active ingredient per gallon. It is moderately effective against codling moth and curculio and is very effective against aphids. Phosphamidon is quickly absorbed into leaf tissue. The use hazard is moderate. The residual effect is short.

Systox (demeton) is formulated as a 26.2-percent emulsifiable concentrate, with 2 pounds of active ingredient per gallon. The primary use is against aphids, mites, leafhoppers, and leaf miners. Its persistence (it lasts 8 to 12 days) has made Systox the most effective systemic chemical against mites. It has a very high use hazard and a strong, penetrating odor.

Miticides

Several miticides are still registered and may be available by local suppliers, but are used very little because widespread resistance has developed in mite populations where these chemicals have been applied for several seasons. After more than 3 years of absence, the effectiveness of miticides may increase enough for economic application. Acaralate and Kelthane are chlorinated hydrocarbons that have been used successfully, allowing adequate survival of predatory mites. Morestan has also been used successfully with predatory mites, but is now re-

stricted to use when no fruit is present. Ovex and Tedion are organic sulfur compounds that are most effective against egg stages, although Tedion also kills young mites and affects the adults. Ovex and Tedion have been used successfully against predatory mites.

Carzol (formetanate) is a nonphosphate miticide formulated as a 92-percent, water-soluble powder. Carzol is a contact miticide that is effective against all stages. It also kills predatory mites. Carzol is moderately persistent. The use hazard is low.

Omite (propardite) is an organic sulfur compound formulated as a 30-percent, wettable powder. Although some resistance has developed, Omite may still be useful against low populations of pest mites since it does not harm predatory mites. Omite is safe on fruit, has a low use hazard, but is only moderately persistent.

Plictran, an hydroxal tin compound, is a 50-percent, wettable powder. It kills all stages on contact. Full dosages have nearly eliminated pest mite populations. Plictran has been used at low dosages while populations are still small, allowing the predatory mites to develop. The use hazard is low. Plictran has a long residual effect.

Vendex is also a tin compound formulated as a 50-percent, wettable powder. Its use patterns have been quite similar to those for Plictran. Vendex is a persistent compound (6 to 10 days) with a low use hazard.

The effectiveness of insecticides and miticides against common orchard pests is given in tabular form at the end of this circular.

Oils

Oils are useful in early season. They are economical to use and easy to handle; they have little use hazard; and as far as we know, no pests have developed resistance. The oils now being widely used are known as "superior" oils.

Although specifications for superior oils have not been legally established, the major suppliers follow standards developed by the New York State Agricultural Experiment Station at Geneva. These standards were established by employing methods published by the American Society for Testing Materials. The standards are given in the following table.

Viscosity is a measure of the rate of oil flow. The gravity test provides an index on the amount of paraffin in the oil when related to viscosity and the unsulfonated residue. Unsulfonated residue (UR), a measure of refinement, indicates the percentage of stable chemicals that are not toxic to the plant. Many of the superior oils have UR's of 94 to 96 — higher than specified in the table.

The pour point indicates the lowest temperature at which an oil will pour freely. The temperature range of distillation limits both the number of chemicals and the size of the chemical structures in the oil. Viscosity and UR specifications are usually given on superior oil labels.

STANDARDS FOR SUPERIOR OILS

Developed by the New York Agricultural Experiment Station

Property	60-second superior oil	70-second superior oil	100-second superior oil
Saybolt Universal Viscosity at 100°F., seconds[a]	56-62	66-74	90-120
Gravity, API (minimum)[b]	34	33	31
Unsulfonated residue (minimum)[c]	92	92	90
Pour point °F. (maximum)[d]	20	20	30
Distillation at 10 mm. Hg, °F. (50% point)[e]	408 ± 10 (645 ± 8)	425 ± 12 (670 ± 10)[f]	A relatively narrow distillate portion of petroleum
10%-90% range (maximum)	80 (75)[f]	95 (90)[f]	

[a] ASTM methods D445-61 and D446-53 to be used. [b] ASTM method D287-55 to be used. [c] ASTM method D483-61T to be used. [d] ASTM method D497-57 to be used. [e] ASTM method D1160-61 to be used. [f] ASTM method D447-59T to be used.

Superior oils are more efficient than other oils in smothering insects because they have more of the effective paraffins and fewer of the undesirable hydrocarbons.

For oils not classified as superior oils, the label usually lists the percentage of petroleum oils only. These oils are usually labeled as dormant oils, and they may vary widely in chemical content. This variation makes it risky to use them after bud-break.

On a dilute basis, 2-percent oil is enough to control scale insects and European red mite eggs during the dormant period. The dosage may be gradually decreased to 1 percent in the early pink stage, when European red mite eggs begin to hatch and scale insects begin to grow. This dosage is also effective on hatched mites and on other insect forms. The control efficiency, however, depends more on the coverage than on the dosage.

If possible, oil should be sprayed under reasonably calm conditions or with the wind. Spraying with the wind usually means that opposite sides have to be sprayed at different times. One or both sides may require respraying to insure complete coverage. A second application gives some increase in control, even when both applications are made under calm conditions.

Used alone, the 70-second superior oils may be applied with little harm to the plant until temperatures get above 80°F. However, complicated pest-control programs for fruit trees greatly limit the use of oil. Most pesticides are conditioned by various solvents, emulsifiers, and dilutents which cause incompatibilities with the oil. The following pesticides are considered to be compatible when mixed singly with superior oil: Benlate, Cyprex, zineb, Polyram, ferbam, and most of the wettable

powder insecticides recommended during the dormant to prepink stage. When several of these pesticides are to be used together, however, a trial mix should be made in a glass jar. If the mixture is not smooth and uniform, then the materials should be considered incompatible. The oil should always be added with agitation after other pesticides have been mixed in the tank and before the tank is completely filled with water. Do not allow the mixture to stand without agitation before spraying.

After leaves appear, oil should not be applied to trees shortly before, with, or soon after sulfur, captan, or the organic dinitros — Karathane, Dikar, and Morocide. The use of these materials directly after oil may injure the leaves.

Growth Regulators

Amid-Thin (naphthaleneacetamide) is used as an apple-thinning agent, mainly for summer varieties.

Alar (succinic acid 2,2-dimethyl hydrazide) is marketed as an 85-percent wettable powder. It is used to initiate the formation of fruit buds and to prevent a preharvest drop of the apples.

Ethrel is an ethylene-releasing compound that is marketed as a 21-percent liquid. It has several uses on fruit crops.

NAA (naphthaleneacetic acid) is marketed as 3½- and 7-percent wettable powders. It is used on apples for chemical thinning and for preventing preharvest drop.

Sevin (carbaryl) is an insecticide which has fruit-thinning action on apples from petal-fall to 25 days after petal-fall.

2,4,5-TP [2-(2,4,5-trichlorophenoxy)propionic acid] is formulated both as a herbicide (Silvex) and as a preharvest drop-preventive for apples (Color-set, Color-fix, etc.). Do not confuse 2,4,5-TP with 2,4,5-T (2,4,5-trichlorophenoxyacetic acid), which is a brush-killer.

EFFECTIVENESS OF FUNGICIDES AND BACTERICIDES AGAINST ORCHARD DISEASES[a]

(This list is not to be used as a group of recommended chemicals)

Materials in 100 gallons of water	Effectiveness of materials on											
	Apple scab	Bitter rot	Black rot	Apple blotch	Botryosphaeria rot	Peach brown rot	Flyspeck, sooty blotch	Peach leaf curl	Peach scab	Powdery mildew	Rust diseases	Rhizopus
Benlate 50W	G	O	O	O	O	G	G	O	G	G	NG	NG
Botran 50W	NG	O	NG	O	NG	M	O	O	O	O	O	G
Bordeaux	G	G	G	G	M	O	G	G	O	G	P	O
Captan 50W	G	G	M	P	M	G	G	G	P	NG	NG	P
Copper (Fixed)	G	G	G	G	M	O	G	G	O	M	P	O
Cyprex 65W	G	P	P	P	P	NG	G	G	M	NG	P	NG
Dichlone 50W	M	NG	NG	NG	NG	G	G	G	G	NG	NG	NG
Difolatan 4F	G	O	O	O	O	O	O	O	O	O	O	O
Dikar	G	M	M	G	O	O	G	O	O	G	G	O
Ferbam 76W	M	G	M	G	O	M	G	G	M	NG	G	O
Glyodin	M	M	M	NG	O	P	G	O	O	NG	NG	O
Karathane 25W	NG	NG	NG	NG	NG	NG	NG	NG	NG	G	NG	O
Niacide M	G	G	M	G	NG	O	G	O	O	NG	G	O
Phaltan 50W	G	C	G	P	G	O	G	O	O	NG	NG	O
Polyram 80W	G	G	M	G	O	O	O	O	O	O	G	O
Sulfur	G	NG	NG	NG	NG	G	M	G	G	G	NG	NG
Thiram 65W	M	O	O	G	O	O	M	O	NG	O	G	M
Triarimol[b]	G	O	O	O	O	G	O	O	O	G	O	O
Zineb 75W	G	M	M	G	P	O	G	O	O	NG	G	O

G — Good; M — Moderate; P — Poor; NG — No Good; O — Not recommended or no information.

[a] There are only two bacterial diseases of concern to the orchardist: fire blight and bacterial spot. Fire blight is best controlled by streptomycin 50 to 100 ppm. Bordeaux mixture (1½-1-100) is sometimes used effectively. Bacterial spot of peach is not controlled by any chemical when the season is favorable for its development.

[b] On nonbearing apples only.

EFFECTIVENESS OF CERTAIN INSECTICIDES AND MITICIDES AGAINST ORCHARD PESTS AND PREDATOR MITES

(This list is not to be used as a group of recommended chemicals)

Materials in 100 gallons of water	Effectiveness of materials on										
	Aphids	Apple maggot	Codling moth	European red mite	Spotted mites	Predator mites	Oriental fruit moth	Plum curculio	Red-banded leaf roller	Scale	Cut-facing insects
Acaralate (2 lb./gal.), 2 pt.	NG	NG	NG	M	M	NG	NG	NG	NG	NG	NG
Carzol 92WP, ½ lb.	NG	NG	NG	M	M	M	NG	NG	NG	NG	NG
Cygon (4 lb./gal.), ½ pt.	G	NG	P	P	P	M	NG	M	P	M	NG
Diazinon 50W, 1 lb.	G	M	G	P	P	P	G	M	P	G	NG
Ethion 25W, 2 lb.	M	P	M	P	P	M	NG	NG	NG	M	NG
Guthion 50W, ⅝ lb.	M	G	G	NG	NG	P	G	G	G	P	M
Imidan 50W, 1½ lb.	M	G	G	P	P	P	G	G	P	P	M
Kelthane 35W, 1 lb.	NG	NG	NG	M	M	NG	NG	NG	NG	NG	NG
Lannate (1.8 lb./gal.) 2 pt.	M	P	G	NG	NG	G	G	P	M	P	M
Lead arsenate, 3 lb.	NG	M	P	NG	NG	NG	NG	M	P	NG	NG
Malathion 25W, 2½ lb.	G	M	M	P	P	P	M	P	M	G	P
Morestan 25W, ½ lb.	NG	NG	NG	G	G	NG	NG	NG	NG	NG	NG
Omite 30W, ½ lb.	NG	NG	NG	M	M	NG	NG	NG	NG	NG	NG
Ovex 50W, ½ lb.	NG	NG	NG	M	M	O	NG	NG	NG	NG	NG
Parathion 15W, 2 lb.	M	M	G	P	P	P	G	G	M	G	M
Phosdrin (2 lb./gal.), 1 pt.	G	NG	P	M	M	M	NG	NG	G	M	NG
Phosphamidon (4 lb./gal.), ½ pt.	G	NG	P	P	P	P	NG	NG	NG	M	NG
Plictran 50W, ¼ lb.	NG	NG	NG	G	G	NG	NG	NG	NG	NG	NG
Sevin 50W, 2 lb.	M	M	G	NG	NG	G	G	M	M	M	G
Systox (2 lb./gal.), ¾ pt.	G	NG	NG	M	M	M	NG	NG	NG	G	O
Tedion (1 lb./gal.), 1 pt., or 25W, 1 lb.	NG	NG	NG	M	M	NG	NG	NG	NG	NG	NG
Thiodan 50W, 1 lb.	G	NG	NG	NG	NG	M	NG	NG	NG	NG	M
Trithion 25W, 1 lb.	M	NG	M	P	P	M	P	NG	P	M	NG
Vendex 50WP, 4 oz.	NG	NG	NG	G	G	NG	NG	NG	NG	NG	NG

G — Good; M — Moderate; P — Poor; NG — No Good; O — No information.

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